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JAN 1926

Editor:

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JANUARY, 1925.

Editorial

A MOST IMPORTANT ORIGINAL RESEARCH.

IN this month's number we are proud to be able to publish the results and full details of a very important bacteriological research on jaundice of the dog by the combined efforts of two members of our own profession, Messrs. T. Dalling and L. P. Pugh, and a member of the sister profession, Dr. Okell. It is another illustration of the value of work done in a comparative manner, for the lines of research in both human and veterinary medicine are frequently parallel.

The article is so important that we feel no apology to our readers is required for having acceded to the request of the joint authors to publish it in one issue, even although it occupies the greater part of our available space. Its importance (and in this we are sure everyone will agree) justifies it.

Every veterinary surgeon knows how fatal jaundice is when once it has attacked the canine species, and in this instance not only is the new discovery demonstrated of the causal organism, but the authors have prosecuted their inquiries to the stage of being able to assert that they can now demonstrate preventive measures which will effect a cure.

We congratulate these workers on the results which they have obtained, and the profession owes them a deep debt of gratitude. We are therefore of the opinion that we cannot bring the subject too strongly under the direct notice of the profession.

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ANOTHER OPPORTUNITY FOR ORIGINAL RESEARCH.

We draw the urgent attention of our younger graduates to another opportunity for original research, which is offered to our profession, in the shape of a position as Assistant in Helminthology at the London School of Hygiene and Tropical Medicine, Molet Street, London, W.C. 1, at a salary of £500 per annum, plus superannuation under the University Federated Superannuation Scheme.

It is essential that the candidate shall possess a Science Degree in addition to a registrable qualification in either human or veterinary medicine.

This is the first time that such a post has been opened to veterinary graduates, and we hope that some of our members who possess the necessary qualifications (and we have now amongst us quite a considerable number who have taken a University B.S. degree as well as the M.R.C.V.S. diploma) will apply, and that one of them may be the successful candidate. In doing this they will not only benefit themselves, but will also do good pioneer work for their Alma Mater, the veterinary profession.

THE PAST HISTORY OF FOOT-AND-MOUTH DISEASE IN GREAT BRITAIN.

Our readers will be interested in an article on the above subject in this present issue from the pen of Major-General Sir Frederick Smith, which comes very opportunely at the present time, especially as we have real reason to hope that this troublesome plague is at last within measurable distance of disappearance from our midst.

The article illustrates full well that the difficulties of eighty-five years ago were much the same as now—perhaps even greater—and it emphasises the fact that the question of foot-and-mouth disease is one for Government decision and control, to be dealt with (as in the present day) by Government officials acting under the orders of a central body, such as the Ministry of Agriculture.

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General Articles

LEPTOSPIRAL JAUNDICE IN DOGS (YELLOWS).

By C. C. OKELL, *M.C.*, M.B. Camb., M.R.C.P. Lond.,
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Wellcome Physiological Research Laboratories, Beckenham, Kent.
and L. P. PUGH, B.Sc., F.R.C.V.S.,
Sevenoaks.

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Enzoötic Jaundice (yellows) is a troublesome disease often brought to the notice of veterinary surgeons. It occurs in all parts of Britain, particularly in hunting districts, while some areas, e.g. London, are comparatively free. More cases are met with in country districts than in towns, especially amongst sporting dogs, though all kinds of dogs are liable to attack. Sporadic cases are met with amongst adult dogs, but most of the reported cases come from foxhound and breeding kennels where many dogs are housed together. Here it particularly affects young dogs as an enzoötic. Wallis Hoare (1915) says: "Except in mild cases the mortality is very high, and we frequently find that an entire litter of puppies may succumb to the infection." This statement agrees with our own experience, for in the outbreaks we have investigated the mortality has reached at least 95 per cent.

We think that our experiments and observations have reached a convenient stage for publication, though many points remain for further investigation.

Symptoms in Naturally Occurring Cases.

The following description of the symptoms seen in naturally infected dogs is based on personal observations made during the outbreaks we have studied. We believe that careful clinical observation shows that the disease can be divided into two main types with every gradation between. We have named these types the hyperacute hæmorrhagic type and the icteric type.

(*a*) The Hyperacute Hæmorrhagic Type.

The chief characteristics are:—

(1) *Sudden Onset.*—A puppy may be seen playing with its fellows, and an hour later may be found huddled up in the darkest corner of its shelter.

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(2) *Temperature.*—When taken at the onset, the temperature is high, varying from 104° F. to 106° F. Death is always preceded by a sudden fall of the temperature to 97° F. or 98° F.

(3) *Nervous Symptoms.*—There is intense depression. Shivering is occasionally exhibited. Manipulation of the muscles of the neck or abdomen often causes pain. In a few cases symptoms of meningitis have been observed. Occasionally hiccough is met with.

(4) *Respiratory Symptoms.*—Epistaxis is common. The respirations are increased and may be laboured in severe cases. Bronchial râles are very evident, and may sometimes be heard several yards away from the patient, and there may be a soft repressed cough.

(5) *Alimentary Symptoms.*—Hæmorrhagic herpes of the lips is common, and frequently there is bleeding from the gums. Vomiting occurs in all cases, and is specially marked when water is allowed. Blood may be found in the vomitus. Thirst is always a prominent symptom. In most cases there is frequent passage of soft fæces in small amounts, often blood-stained and accompanied by tenesmus. Hæmorrhage into the alimentary tract has apparently been the cause of death in some cases.

(6) *Urine.*—The urine is passed in small amounts and occasionally contains bile pigment. All samples examined after death have shown an abundance of albumen.

(7) *Other Symptoms.*—The face may be swollen below the eyes. The cervical lymphatic glands are not infrequently enlarged. Petechiæ have been observed on the skin of the flank and under the arms. An intense conjunctivitis may be present; some cases have shown a mild inflammatory condition of the eye with a slight purulent discharge. As a rule icterus is not present. The disease runs a rapid course, death occurring in a few hours after the onset, but occasionally the dog lives for two or three days.

(*b*) The Icteric Type.

(1) *Onset.*—In this type the onset varies. In the rapidly fatal form with jaundice the onset is acute, while in other cases the disease may be so insidious that the dog is not thought to be sick until the development of obvious jaundice.

(2) *Temperature.*—In the majority of cases that show well-marked jaundice the initial temperature is generally 102° F. or 103° F. As icterus becomes apparent on the gums and conjunctivæ, the temperature falls to normal or subnormal. A subnormal temperature is practically constant before death.

(3) *Nervous Symptoms.*—There is a tendency for affected dogs to

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hide away and rest and to avoid muscular exercise. There is not the marked depression seen in the hyperacute type, and affected puppies often appear at times quite lively. As the disease develops depression becomes more marked. In uncomplicated cases there is no very obvious muscular tenderness, but when intussusception has occurred the abdominal muscles are held rigid.

(4) *Respiratory Symptoms.*—Generally cough is absent, but bronchial râles can be detected easily in the more acute cases. Epistaxis has been observed, but is uncommon.

(5) *Alimentary Symptoms.*—The mucous membrane of the mouth usually appears healthy and free from mucus. The gums are yellow, the degree of pigmentation depending on the stage of the disease at the time of examination. Vomiting is fairly constant, and blood may be found in the vomitus. Constipation is usually marked, and the fæces when removed by lavage are pale and clay-like. As the disease progresses the motions become loose and blood-streaked. Intussusception of the small intestine can often be diagnosed by palpation of the abdomen, and is frequently the immediate cause of death. Prolapse of the rectum has been observed.

(6) *Urine.*—The urine is usually darkly coloured with bile pigment, and contains much albumen.

(7) *Other Symptoms.*—The superficial lymphatic glands are not often swollen in this type. Pruritus appears to be fairly common. Conjunctivitis is often present in the more acute cases.

The day of the disease upon which jaundice appeared in each of the dogs we have had under observation is shown in Table I.

Associated with outbreaks of enzoötic jaundice, cases occur where dogs show a slight fever and transient gastro-intestinal disturbance. The fact that these cases occur so frequently in association with enzoötic jaundice, in our view suggests strongly that they are mild cases of the same infection, but experimental proof is as yet lacking.

Acute cases may die within two days from the onset; milder cases may survive a week or more. Dogs which recover often develop conjunctivitis or keratitis as sequelæ.

Morbid Anatomy in Naturally Occurring Cases.

As a rule, there is marked jaundice of the walls of the abdomen, the plantar surface of the paws, inside the ears, etc. All degrees, from a faint yellow tinge to a deep chrome colour, have been observed. In the hyperacute case jaundice may be absent. Shreds of blood-stained mucus often protrude from the anus. There may be a thick catarrhal discharge from the eyes or nose or both, and a frothy blood-

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stained saliva may be discharged from the mouth. Punctate hæmorrhages may be seen under the arms. The subcutaneous fat is icteric. The *peritoneum* may appear normal or may show punctate hæmorrhages, either discrete or confluent, forming red patches on an icteric background. The *peritoneal fluid* may appear normal, or may be bloodstained and increased in amount. All the abdominal blood-vessels are markedly congested. The *stomach* in many cases appears normal, in others it shows petechiæ, which may involve any part, including the pylorus. Occasionally the whole of the stomach is affected. These hæmorrhages are seen from the exterior of the stomach, and can be shown by dissection to be both subserous and submucous. In cases of sudden death, the stomach may contain coagulated blood. The *intestines* usually show varying degrees of inflammation, varying from bright red to a dark blue or almost black colour. Petechiæ may be seen in any part of the small or large intestine, and are submucous and subserous. Large portions or even the whole of the intestine may be thus affected. The small intestine suffers more than the large, and the jejunum and ileum more than the duodenum.

Intussusceptions are very frequent, and occur chiefly in the small intestine ; a prolapse of the rectum was seen in one case. The *liver* is usually enlarged and congested, or on the other hand it may be pale and icteric. The *gall bladder* usually contains much bile. The *kidneys* may be congested or may be pale and icteric. Petechial hæmorrhages may be present in the cortex. The *urinary bladder* usually contains some bile-stained urine. The bladder wall may show punctate hæmorrhages. The *lungs* in all cases show a very characteristic appearance. Bright red, punctate hæmorrhages are found scattered all over the surface, and are present in the substance of the lung. They may be small and discrete, or consist of irregular areas up to an inch in diameter. When such lesions are few in number, they are found mostly near the thin margins of the lung. In some cases a few lesions only can be found, in others the whole lung is involved.

The *pleura, pericardium, and endocardium* may appear normal or show hæmorrhages. Exudates of a serous or sero-fibrinous character may be found in the pleural and pericardial cavities. There may be small hæmorrhages in the *heart muscle*. The *spleen, pancreas, and thyroid* are usually normal in appearance. The *suprarenals*, though often apparently normal to the naked eye, generally contain hæmorrhages in their substance. The *thymus* may appear normal or may contain petechiæ. The *lymphatic glands* of the thorax and abdomen are almost invariably enlarged, dark, and hæmorrhagic ; all glands

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may be affected. The *eye* may be normal or inflamed; the sclerotic is usually icteric. Hæmorrhages and jaundice may be seen on the *gums*. Hæmorrhages, mainly interstitial, may occur in the *skeletal muscles*. The *brain and spinal cord* show no abnormalities.

EXAMINATION OF DOGS WITH SPECIAL REFERENCE TO ETIOLOGY.*

Dog 1.—The liver ground up in a mortar while in a fresh condition was examined by dark-ground illumination, and several typical motile leptospiræ about 10 μ in length were seen. The ground-up spleen and mesenteric glands were also examined, but no leptospiræ were found. In Giemsa smears no leptospiræ were seen. Examination of sections of liver, lung, and spleen by Dobell's modification of Levaditi's method showed no leptospiræ.

Five guinea-pigs were inoculated intraperitoneally with 1 c.c. of ground-up liver; all died about one month later, but not with the typical picture of leptospiral jaundice. In the ground-up tissues of these guinea-pigs no leptospiræ were found except in the liver of one animal, where a few doubtful forms were seen.

Dog 2.—Leptospiræ were not found in ground-up liver, in Levaditi sections of liver, lung, spleen, mesenteric gland, suprarenal, or in cultures. Three guinea-pigs were each inoculated intraperitoneally with 1 c.c. of ground-up liver. All three died with the typical post-mortem picture of leptospiral jaundice, i.e. jaundice with hæmorrhages in practically all the tissues, including the lungs.

The further history of this strain and its passages is shown in Chart I. What appeared to be a pure culture of the organism was obtained, and this culture produced the typical disease in both dogs and guinea-pigs. A serum obtained by injecting a horse with a known strain of rat leptospira (Rat 2 leptospira) was found to give complete protection against the organism, and neither normal horse serum nor normal dog serum had this power. It will be seen that one dog (Exp. Dog 2), which had been injected with this strain and had developed definite jaundice, recovered after a short illness. A month after inoculation, and about three weeks after the appearance of jaundice, the dog showed no jaundice, and was apparently perfectly well in every particular. It was then killed. In the lungs were present the remains of old hæmorrhages. No abnormalities were present elsewhere. The ground-up liver showed no leptospiræ, but many freely motile and typical leptospiræ were found in the ground-up kidney. The urine was also examined and contained what appeared to be dead leptospiræ. Guinea-pigs inoculated with the ground-up

* For the method of numbering the dogs we have examined, *vide* p. 21.

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kidney of this dog failed to contract the disease. The serum of thi dog was used in subsequent cross-protection experiments, and is referred to as Dog 2 leptospira serum. This dog serum showed high protective properties against Dog 2 leptospira, Dog 3 leptospira, and Rat 2 leptospira, our standard rat strain. The cross-protection of the Dog 2 leptospira serum and the rat leptospira serum was indeed complete, and both sera were protective against Dog 3 leptospira.

A further experiment is indicated in the chart, where the strain was inoculated into two guinea-pigs without serum and into one guinea-pig which had previously been given the serum of a dog which had recovered from the natural disease. This sample of serum was, unfortunately, very small, and had become contaminated. The control animals died on the fourth day, while the guinea-pig which received the serum of the dog which had recovered remained quite well until the end of the fifth day. It then died apparently from a peritonitis due to a Gaertner-like bacillus. No signs of jaundice or hæmorrhage were found post-mortem, and no leptospiræ could be found by dark-ground examination. The strain from this dog is referred to as Dog 2 leptospira.

Dog 3.—After a prolonged search, several definite leptospiræ were seen by dark-ground examination of the various ground-up organs of this animal. Four guinea-pigs were injected intraperitoneally with 1 c.c. of ground-up liver substance, but none died of the disease. A culture taken directly from the liver of this dog showed, however, a pure growth of leptospiræ. The further history of this strain (Dog 3 leptospira) is shown in Chart II. When given intraperitoneally 1·5 c.c. of culture, two guinea-pigs developed the typical disease. Five days later they died with typical symptoms and post-mortem appearances, and numerous leptospiræ were found in the ground-up livers. A dog was also infected with this culture (Exp. Dog 5), and died nine days later with typical symptoms and post-mortem appearances. The ground-up liver of this dog showed a number of forms somewhat resembling leptospira, but a definite opinion as to their nature could not be expressed. Four guinea-pigs inoculated from the dog's liver did not develop the disease. Thus, even where an apparently pure culture of leptospira was injected into a dog and the typical disease produced, the same difficulty in retrieving the leptospira from the dog was met with as in a number of cases of the natural disease. The chart further shows that guinea-pigs are protected from the leptospira by anti-Rat-2-leptospira horse serum, and by the serum of the dog which had recovered after infection with the leptospira from Dog 2. Normal horse and dog sera gave no such protection.

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Levaditi sections of the liver, lung, spleen, kidney, and suprarenal of Dog 3 showed no undoubted leptospiræ, but sections of one of the hæmorrhagic lumbar glands of this dog showed numerous leptospiræ. These appearances are shown in a photograph of a section shown in Fig. 2. The strain from this dog is referred to as Dog 3 leptospira.

Dog 4.—Dark-ground examination of ground-up liver showed a number of doubtful elements resembling leptospira, but a definite decision could not be made. The ground-up spleen, glands, kidneys, suprarenals, and also the heart blood showed no forms resembling leptospira. Leptospira could not be cultivated from the liver, and none were seen in Levaditi preparations of the important organs, or in blood-smears stained with Giemsa stain.

Four guinea-pigs were inoculated with ground-up liver and with a mixture of the organs; none developed the typical disease, though two died thirteen days later without any typical appearances. A dog inoculated with 4 c.c. of a mixture of ground-up liver and spleen remained unaffected.

Further histological work on the materials from this dog is in progress, but up to the present we have been unable to demonstrate the presence of leptospira, though the clinical history and post-mortem appearances were typical of leptospiral jaundice in dogs.

Dog 6.—Dark-ground examination of the ground-up liver of this dog showed a number of forms very closely resembling leptospira, but they did not satisfy our criteria of characteristic motility, and they could not be properly resolved under a high power into primary spirals. We thus registered them as probably, but not certainly, leptospiræ.

Four guinea-pigs were injected intraperitoneally with the ground-up liver of this dog, and all died about three weeks later, two of them showing definite hæmorrhages in the lungs, but no jaundice. No leptospiræ were seen in the organs of these guinea-pigs. A puppy was also injected with 3 c.c. of the ground-up liver of this dog, but it remained unaffected.

No leptospiræ were seen in Levaditi preparations of liver, lung, kidney, spleen, suprarenal, or lymphatic glands. In this dog, as in Dog 4, it has been impossible to isolate leptospira, though the clinical and post-mortem pictures were typical.

Dog 7.—The post-mortem of this puppy was not done in the laboratory. Small pieces of liver, a kidney, and a lung only were received. The lungs contained typical punctate hæmorrhages. The case was regarded by the veterinary practitioner who attended it as one of "distemper with jaundice." A few suspicious forms were seen in the liver and lungs. The specimens were, however, contami-

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nated, and the guinea-pigs inoculated with the material died from peritonitis within forty-eight hours. No leptospiræ were seen in Levaditi preparations of the liver, lung, kidney, spleen, and lymphatic gland of this dog.

Dog 8.—An adequate examination of fresh tissues for leptospira was not possible in this case. No leptospiræ were seen in Levaditi preparations of liver, lung, kidney, and other organs. Six guinea-pigs and two dogs were inoculated with ground-up liver and other organs, but no infection took place.

Dog 9.—A very exhaustive examination of the fresh material from this puppy was undertaken, but only in the liver were some suspicious elements seen by the dark-ground method. Four guinea-pigs were inoculated intraperitoneally, each with 1 c.c. of ground-up liver. All four subsequently died with slight but definite jaundice, and otherwise with the typical post-mortem appearances of leptospiral jaundice. Numerous definite leptospiræ were seen in the liver by dark-ground illumination. The guinea-pig's liver was ground up and injected into a further series of guinea-pigs, and produced the typical disease. Four guinea-pigs were protected with anti-Rat 2 leptospira horse serum and inoculated with a test dose of ground-up liver rich in leptospiræ. All remained well. Four control guinea-pigs injected at the same time with the same inoculum died typically in three days.

The anti-horse serum made from a rat strain therefore gives complete protection against this strain in the same way as it gives protection against Dog 2 and Dog 3 strains. Further experiments with this strain are in progress. The histological examination is not yet completed. The strain seems to be definitely more virulent to guinea-pigs than our standard rat strain, the test dose killing guinea-pigs within three days, whereas our rat strain kills almost constantly in four days.

Dog 10.—This puppy belonged to the same litter as Dog 9, and showed an almost exactly similar clinical and post-mortem picture. No leptospiræ were found, and eight inoculated guinea-pigs remained healthy. Histological examination has not yet been completed.

The Experimental Infection of Dogs with a Leptospira Strain of Rat Origin.

Three puppies were inoculated with a rat strain (Rat 2 leptospira), kindly sent to us by Dr. George Buchanan. The rat had come from a Scottish mine in which cases of leptospira infection had occurred in human beings. This gave rise to the typical clinical

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course and post-mortem appearances of the natural disease (*vide* account of Exp. Dogs 1, 15, and 16). The infection was fatal to Exp. Dogs 15 and 16. Exp. Dog 1 was killed *in extremis*. In the case of the latter dog, exhaustive search of the organs was undertaken by dark-ground method, and only after four hours' search could a few undoubted leptospiræ be found. This illustrates the frequent difficulty of finding the leptospiræ even in cases where the disease is produced by the inoculation of definite leptospiræ of rat origin. Four guinea-pigs inoculated from the organs of this dog died typically, and leptospiræ were seen in the liver of all of them. In the case of Exp. Dog 15, fairly numerous leptospiræ were seen in the ground-up liver. A prolonged search through the organs of Exp. Dog 16 failed to reveal any leptospiræ. Death followed in all of the cases within six to seven days after the inoculation, and the third dog was dying six days after inoculation. Jaundice developed in each dog on the fifth day after inoculation.

Symptoms in Experimentally Infected Dogs.

(*a*) *Dog Strain Leptospira Infections.*—(Exp. Dogs 2, 3, 4, 5, 6, 7, 12, 13, 17, and 18, *vide* pp. 24–26.) Puppies inoculated with a strain of leptospira isolated from a dog suffering from jaundice present symptoms indistinguishable from those of the naturally occurring disease. The hyperacute hæmorrhagic type has not been observed in these experimentally infected animals. Symptoms usually develop in the following sequence: pyrexia, constipation, serous or purulent discharges from the eyes and nose, depression, loose clay-coloured stools, often blood-stained, vomiting, jaundice, a rapid fall in temperature to normal or sub-normal, dark-coloured urine, increase in the intensity of jaundice, great depression, intussusception, a weak rapid pulse, death. A fall in temperature at the time of the appearance of jaundice is constant. It is not uncommon to find the inoculated dog apparently perfectly healthy for several days after inoculation, when the above train of symptoms develops suddenly, and death occurs within twenty-four hours of their onset. Intussusception can generally be found by palpation of the abdomen. The superficial lymphatic glands may be enlarged. Pruritus has been observed. One dog (Exp. Dog 2) developed mild symptoms and subsequently recovered.

(*b*) *Rat Strain Leptospira Infections.*—(Exp. Dogs 1, 15, and 16, *vide* pp. 26, 27.) Puppies inoculated with strains of leptospira obtained from rats show symptoms indistinguishable from those presented by puppies inoculated with dog strains or suffering from the natural disease.

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Incubation Period in Experimentally Infected Dogs.—The period between infection and the development of jaundice in the experimental series of dogs is shown in Table II. The day of death is also indicated in the table.

Morbid Anatomy in Experimentally Infected Dogs.

(*a*) *Dog Strain Leptospira Infections.*—(Exp. Dogs 2, 3, 4, 5, 6, 12, 13, 17, and 18, *vide* pp. 22–26.) A perusal of the individual case histories will show that the general post-mortem lesions agree with those found in the naturally occurring disease. One dog developed little or no jaundice, but presented all the other lesions associated with leptospiral infection (*vide* Exp. Dog 13). The *lung* lesions have been most typical, and have varied from a condition where the whole lung was involved (Exp. Dogs 3 and 4) to that where hæmorrhages could only be found after a careful search (Exp. Dog 13). Punctate hæmorrhages on the serous membranes were constantly present. Enlarged *lymphatic glands* have been seen in all cases, many showing discrete hæmorrhages, others being highly congested and dark blue or almost black. The *mesenteric, sublumbar, hepatic, and bronchial glands* have been almost always affected. The *liver* may be either congested or pale and in an obviously degenerated condition. The *intestines* have always shown hæmorrhages and inflammatory lesions. Intussusception was present in most of the cases.

(*b*) *Rat Strain Leptospira Infections.*—The post-mortem appearances in dogs infected with a strain of leptospira of rat origin have been identical with those dying from the natural disease or as a result of inoculation with a strain of canine origin.

General Conditions of Experimental Work.

The ground-up organs used throughout all our experiments on both the natural and the experimental disease were as fresh as possible, and usually only an hour or two old. Only young puppies which we believed had never had distemper or other grave disease were used for our experiments. The ease with which artefacts may be mistaken for leptospiræ in blood, freshly ground-up organs, and also in stained sections was always in our minds and where we state that definite leptospiræ were present, we mean such forms were present as could not possibly be confused with non-living artefacts. Our criteria were that the leptospiræ should have the usual morphology, should have the characteristic appearance of rotary motility, and should be capable of resolution into primary spirals under a dark-ground system, consisting of a Beck compensated (XII) eyepiece, a 2 m.m. apochro-

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matic objective (1·2 NA Beck) and a Beck focusing dark-ground condenser (1·2 NA). Although we have noted less typical elements in some of the dogs, we have refrained from making any deductions as to their nature.

Horse Serum used in Experiment Work.—The anti-leptospira horse serum made from the rat strain (Rat 2 leptospira) has been titrated on many occasions against its homologous strain. The test dose consisted of 1 c.c. of liver rich in leptospiræ ground up in saline and filtered through a little cotton wool. The dose was given intraperitoneally. This somewhat severe test is the method employed by Griffith (1919). No preservative was present in the serum. Chart III shows a typical titration of this serum which has been used throughout our experiments as our anti-leptospira serum of rat origin. Chart IV gives a protocol of some typical experiments performed with the Rat 2 strain.

Dog Experiments.—The following precautions were taken in order to avoid fallacies due to uncontrolled infection of our animals. Dogs infected with rat leptospiræ were never placed in the same room as those infected with the natural disease or passages therefrom. Each dog was isolated from the others, and laboratory attendants always were completely dressed in rubber gowns, "gum boots," and rubber gloves. These were washed down with lysol before and after attending each animal, and mats impregnated with lysol were provided for the cleansing of boots. In some of the more critical experiments the dogs were isolated in separate buildings, and each animal entrusted to a special attendant. The general precautions were such as we thought might reasonably be expected to control the infection of any highly contagious disease.

Guinea-pig Experiments.—We have observed many hundred guinea-pigs infected with leptospira, and have never so far met with a contact infection of any kind. Many normal guinea-pigs have been allowed to intermingle freely with infected stock without contracting the disease. We have, however, taken the greatest care to guard against this possibility so far as this could be done in one guinea-pig house. Our senior laboratory assistant, Mr. Tottem, who has long experience in infectious animal work, has had almost complete care of the animals. They have never been handled with the naked hands. Rubber gloves have always been used, and the hands have been disinfected with lysol between the handling of every group of animals. As is well known, the leptospira is extremely sensitive even to diluted disinfectants. Needless to say, elaborate precautions were taken to ensure the exclusion of rats from the laboratories. From our previous experience of leptospiral infection we had reason to think that these

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precautions were sufficient, and throughout our experiments we have had no reason to suspect that any cross-infection had taken place.

Examination of Normal Puppies.

We have examined by the dark-ground method and by guinea-pig inoculation a number of normal puppies, and have up to now found no evidence of the presence of leptospiræ. The sera of a number of dogs which had no history of jaundice gave no protection to guinea-pigs against our rat strain (cf. results with the serum of dogs which had recovered from jaundice).

General Discussion of the Experimental Results.

In three cases out of ten of enzoötic jaundice in dogs we were able to isolate leptospiræ which agreed in every respect with a known rat strain of *Leptospira icterohæmorrhagiæ*. In these cases we believe we have satisfied almost completely the postulates of etiology usually required in ascribing a disease to a given micro-organism. The very characteristic appearance of motile leptospiræ and the peculiar post-mortem picture have made it particularly easy to satisfy ourselves at every passage that we were dealing with a leptospiral infection.

We have been less successful in satisfying Koch's important "postulate" that "the parasitic micro-organisms are to be found in all cases of the disease in question." We have brought forward evidence, which is indeed familiar to most workers in this field of pathology, that the leptospira is often exceedingly difficult to recover from animals (other than guinea-pigs), even when the leptospira inoculated has caused a perfectly typical clinical and post-mortem picture. The same difficulty has been met with in demonstrating the leptospira in cases of Weil's disease in human beings (cf. Stokes, Ryle and Tytler (1917), Dawson, Hume, and Bedson (1917) and others). We might also refer to the difficulty that is so often met with in demonstrating *Treponema pallida* in typical syphilitic material. Leishman (1920), in his Horace Dobell lecture on *Spirochæta duttoni*, refers to the difficulty he met with in demonstrating the spirochætes in infected ticks, although the juices of these produced relapsing fever when inoculated into monkeys. In connection with *Leptospira icterohæmorrhagiæ*, we cannot resist mentioning the hypothesis formulated by Leishman in connection with *S. duttoni* that the micro-organism may pass through a stage in its life-history which is either granular or invisible. We find it difficult to explain our own experimental results and those of other workers on leptospira infection, except upon some such hypothesis.

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The consistency of the characteristic clinical and post-mortem appearances, both in naturally and artificially infected dogs, makes it a strong presumption that all the cases were indeed due to leptospiral infection. It may be added that piroplasma could not be found in any of the dogs examined.

Prophylaxis.

It has been frequently shown that anything up to 30 per cent. of the adult rats in many areas both in England and abroad harbour virulent leptospiræ in their kidneys and excrete them in their urine (Stevenson, 1922; Balfour, 1922). The rats themselves may show scarcely any reaction to the parasite, and may be looked upon in the great majority of cases as "healthy carriers" of the disease. In human outbreaks of Weil's disease a close association between man and the rat can nearly always be established, and the large epidemics on the various fronts during the Great War, described by Martin and Pettit, Stokes, Ryle and Tytler, Dawson, Hume and Bedson, and others, were universally referred to the close association between man and infected rats which took place under the conditions of trench warfare.

In the infected kennels we have investigated rats were evidently present in large numbers, and the opportunities of rat contamination gross. In the only two outbreaks where we have had the opportunity of examining rats infesting the kennels, we have demonstrated the presence of virulent leptospira infection in the rats.

We believe that rats are probably the main vectors of the disease, and therefore anti-rat measures appear to be an essential in the eradication of the disease. We are endeavouring to discover by experiment how the natural infection takes place. We think that it is by means of food and bedding. Presumably the food and bedding of the dogs become contaminated with the urine of rat carriers of the disease, and from these materials the puppies become infected. The Japanese workers showed that guinea-pigs may be infected by feeding with infected material, and Courmont and Durand (1917*a*) showed that dogs could similarly be given the disease. It has been stated that leptospira infection may take place through the unbroken skin of guinea-pigs (Inada, etc., 1916*a*). Courmont and Durand (1917*b*) and the present writers have frequently infected guinea-pigs by rubbing a minute amount of material on a scarified area. Infection through bedding may therefore take place. Adult dogs apparently rarely become infected. Two explanations suggest themselves: either the greater acidity of the adult dog's stomach kills any leptospiræ

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taken with the food, or adult dogs are immune because they have already passed through an attack ending in recovery.

Human beings are known to carry leptospiræ in their urine for some time during their convalesence from the disease, and rats are known to carry the infection in their kidneys and urine almost indefinitely. It seems very probable that dogs also may carry the infection in their urine for at least a short time after their recovery; that this actually takes place is strongly suggested by the discovery of leptospiræ in the kidneys, and probably in the urine, of Exp. Dog 2 three weeks after recovery from the disease.

In a recently published paper, Buchanan (1924) has shown that pathogenic leptospiræ may multiply in damp places independently of any mammalian host, and indeed he concludes that rats may owe their infection to this source. These very important observations of Buchanan explain the known effect of telluric conditions (Tohyama, 1924) on the spread of the disease in rats and human beings, and emphasise the importance of kennels being kept as dry and hygienic as possible, for not only may leptospiræ excreted by rats be kept alive for prolonged periods in warm damp kennels, but may even multiply. Possibly, too, under certain favourable conditions, pathogenic leptospiræ may occur in damp kennels and their surroundings without any immediate connection with a rodent host.

Passive Immunity.—We have clearly shown that guinea-pigs can be protected against certainly lethal doses of leptospiræ of canine origin by an immune serum, and our field tests go to prove that a similar protection can be obtained in dogs exposed to natural infection. Of twelve pups which were "contacts" in an enzoötic, seven were inoculated with 5 c.c. anti-leptospira serum, and five were left uninoculated. Two of the five uninoculated dogs developed the disease, while the seven inoculated remained healthy. We believe that anti-leptospira serum will play an important part in prophylaxis. When a dog with jaundice is discovered in a kennel, it should be removed at once from the remaining healthy dogs, and the latter should be isolated either in their present kennel or removed to new quarters. Each should be inoculated subcutaneously with 5–10 c.c. anti-leptospira serum, the dose depending on the size and age of the dog. Any suspicious case should be removed at once. We believe that a dose of serum will confer a passive immunity for about three weeks. Further doses may be desirable if there is any likelihood of the dogs having been exposed to infection since the first inoculation. To guard against anaphylactic symptoms developing if too long a period elapses between a first and a second dose of serum, and to confer an immunity of longer duration, we would provisionally

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suggest an initial dose of 5-10 c.c. at once, followed by a dose of 1 c.c. a week later, and a further dose of 1 c.c. at the end of a fortnight.

Active Immunity.—From the work of Noguchi (1924) and others on guinea-pigs, it is highly probable that a lasting active immunity to the disease may be obtained by the use of vaccines consisting of dead or attenuated cultures of leptospira. We are now investigating the value of such vaccines in the prophylaxis of the disease in dogs, but as yet we are not in a position to make any definite statement as to their utility.

Treatment.

It is yet too early to state that the administration of anti-leptospira serum will affect cures in all cases of enzoötic jaundice. We have received records of ten instances in which serum was administered to dogs suffering from the disease. In every case jaundice was obvious at the time of the administration of the serum. Nine of these, in the opinion of the veterinary surgeons, were saved by the administration of the serum. We at present have an open mind on the question. We have tried to save dogs which we had artificially infected, but we have hitherto been unsuccessful in saving them after jaundice had developed. It may be that the 1 c.c. of ground-liver tissue with which we artificially infected produced a more severe infection than occurs in the natural disease, and that the serum therefore failed to save the animals.

We have found the following general treatment of advantage: The administration of liquid paraffin by mouth and the withholding of all drastic purgatives. Enemata of normal saline solution till a free action of the bowels is obtained. Liquid diet of milk, water, and raw eggs.

The Relationship of Enzoötic Jaundice to Distemper.

Gray (1915) says: "Indeed, it is permissible to doubt the connection between this enzoötic form of jaundice and distemper until some definite knowledge is forthcoming on the subject. No doubt some practitioners meet with cases of distemper that during the course of the disease develop evidence of jaundice, while hepatic lesions are found on post-mortem. In such instances the jaundice is usually regarded as a complication of the disease, but it must be remembered that a dog may be suffering from an unsuspected affection of the liver prior to the attack of distemper."

It is clear that Gray and other observers have realised that dis-

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temper and enzoötic jaundice are two distinct diseases, a conclusion borne out by our findings.

With regard to diagnosis, further observation will probably put the veterinarian in a position to say that at one end of the scale are the typical cases of leptospiral disease, either the form with intense jaundice or the acute form with enteritis, and at the other end are the cases resembling distemper with marked catarrhal symptoms. Instances may, however, occur in which laboratory investigation alone can establish the diagnosis of leptospiral disease as distinct from distemper. Time only can determine the limits in this borderland.

The earlier in the course of the disease one sees the patient, the more difficult it is to make a differentiation between distemper and leptospiral disease. We have provisionally adopted the following points as of help :—

Temperature.—In distemper this is generally persistently high, while in leptospiral disease the early high temperature may drop even to normal or subnormal for several days, followed by a sudden short rise and sudden fall to subnormal.

Depression.—Is greater than in distemper, the patient lying possibly for days and taking no interest in its surroundings.

Hæmorrhagic Herpes and Blood-stained Vomit.—Are very characteristic of leptospiral disease.

Fæces.—In leptospiral disease there can be early diarrhœa, then constipation, followed by the passage of clay-coloured mucoid stools containing much blood, or perhaps only tinted or streaked. How many of the outbreaks of what has been considered intestinal distemper are due to leptospiral disease we cannot tell—probably many. If the serum in use proves in general practice to be as effective in both treatment and prophylaxis as it is at present proving, it will be possible to say that an epidemic that responds to leptospiral serum is not distemper. We shall, of course, take every opportunity available for investigating cases in what we may for the moment regard as the undefined territory between distemper and leptospiral disease.

Note on Weil's Disease in Human Beings.

Some brief mention should be made of the human disease (Spirochætal Jaundice, Weil's Disease) which is due to *Leptospira icterohæmorrhagiæ*. The disease is not common in this country, though occasional outbreaks occur. In Egypt and Japan and many other hot countries it is much more common. During the War many outbreaks took place on both the enemy and the Allied fronts.

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The mortality in most European outbreaks has been low, never probably amounting to more than 5 per cent. (Martin and Pettit, 1919). In Japan, on the other hand, the mortality from the disease has in some outbreaks reached 40 per cent. (Inada, Ido, etc., 1916*b*). The possibility of the disease being conveyed from dogs to human beings must not be overlooked, particularly in the light of Krumbein and Frieling's case (1916), *vide Historical Note.* We hope that any further cases of jaundice in human beings associated with cases in dogs will be fully reported by veterinary and medical practitioners meeting with them.

It is advisable that every care should be taken in handling affected dogs, particularly in doing post-mortem examinations. The virus of the disease, though sensitive to disinfectants, is able to strike rapidly through small abrasions of the skin, and possibly even through the intact skin. Powerful disinfection of the skin a few minutes after the application of the virus is said to be ineffective (Inada, 1916*a*). Rubber gloves should therefore be worn when post-mortems are being performed. The handling of infectious guinea-pig material needs particular care. Cases of infection in laboratory workers have occurred in many laboratories where much work on experimental leptospiral infection has been done; and although apparently no fatality due to laboratory infection is on record, the disease in several of the reported cases has been severe.

For further particulars of Weil's disease in human beings, reference may be made to the monograph of Martin and Pettit, and to the papers by Dawson, Hume and Bedson, Stokes, Ryle and Tytler, and Uhlenhuth and Fromme, and to the classical papers by Inada and his co-workers.

Veterinarians who study the classical accounts of Weil's disease in human beings will, we think, be impressed by the close parallel between the disease in human beings and dogs.

Historical Note.—Courmont and Durand (1917*a*) showed that puppies were susceptible to leptospiral infection. They found that after subcutaneous or intraperitoneal inoculation, or ingestion of infectious material, the puppies contracted typical and fatal jaundice. They state that the evolution of the disease in old dogs is much less typical. Monti (1917) was able to confirm Courmont and Durand's observation. Krukenberg (quoted by Krumbein and Frieling, 1916) was unable to infect dogs from the blood of human patients suffering from Weil's disease. Nicolle and Lebailly (1918), also Uhlenhuth and Fromme (1919), were unable to infect dogs intraperitoneally with infectious material. One of the dogs inoculated by Uhlenhuth and Fromme subsequently developed conjunctivitis and keratitis.

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Martin and Pettit (1919) state that dogs can be inoculated with the virus of Weil's disease, but that the virus can only pass from dog to dog with difficulty. They note that the liver and kidney emulsions only contain very few leptospiræ. Van de Velde (1923) attempted to infect a dog with 2 c.c. of a virulent guinea-pig emulsion, but succeeded only in producing a transient illness followed by keratitis.

Krumbein and Frieling (1916) report an exceedingly interesting association of human with canine jaundice. Two officers living in the same room as a dog suffering from jaundice developed what appeared clinically to be typical Weil's disease. The authors do not appear to have been able to confirm the nature of the infection by pathological methods.

Uhlenhuth and Fromme (1919), while they were investigating an area where cases of human Weil's disease had occurred, met with a case of jaundice in a dog. They considered the condition in the dog to be typical Weil's disease. Examination of the liver of this animal showed a few spirochætes resembling *Leptospira icterohæmorrhagiæ*. A guinea-pig was injected with ground-up liver and remained apparently normal. Seven and a half weeks later the guinea-pig was killed and showed no abnormal post-mortem appearances. Leptospiræ were recognised with certainty in smears from the kidney, and in the liver there were also forms which were probably leptospiræ. In reviewing their own results and the case of Krumbein and Frieling, they state that icterus is uncommon in dogs, and when it occurs it is usually due to duodenal catarrh. They, however, conclude that their own observations and Krumbein and Frieling's case "speak, if not with certainty, at least with great probability for the occurrence of Weil's disease in dogs under natural conditions."

It should be added that Lukês (1924) and Křivácěk (1924) have recently stated that they found spirochætes, to which they give the name *Spirochæta melanogenes canis*, in the tissues of animals which had died of canine typhus (Stuttgart disease).

Summary and Conclusions.

On the basis of clinical and pathological observations and experimental work, the commonly occurring Enzoötic Jaundice of Dogs (Yellows) is attributed to infection with *Leptospira icterohæmorrhagiæ*, which is normally carried by a considerable percentage of rats in this country.

The following are the lines upon which we suggest combating the disease :—

Prophylaxis.—(*a*) Protection of kennels and food from rats. Disinfection of infected kennels. Dry and hygienic condition of floors and bedding.

(*b*) The elimination of "recovered cases" from kennels until it has been proved that they are not excreting leptospiræ in their urine.

(*c*) Complete but temporary protection against the disease is apparently given by passive immunity with a potent anti-leptospira serum.

(*d*) Active immunity will probably be given by suitable doses of a vaccine made from dead or attenuated leptospiræ.

Treatment.—The results obtained in the treatment of the disease with potent anti-leptospira serum have been encouraging.

We owe our thanks to Drs. C. M. Wenyon and R. A. O'Brien, who have given us much help and advice; to Dr. Stevenson, whose opinion we have sought on our histological material; and to Mr. Barnard, of the National Institute for Medical Research, who has kindly made the microphotographs of the leptospira which illustrate this paper. Our thanks are also due to several veterinary surgeons who have supplied us with material for investigation, in particular to Professor Hobday.

Case Index.

The naturally occurring cases of the disease are numbered throughout this paper as follows: Dog 1, *Dog* 2, *Dog* 3, *etc. The experimentally infected dogs inoculated with material of either canine or rat origin are numbered: Exp. Dog* 1, *Exp. Dog* 2, *etc.*

Dogs suffering from the natural disease.

Dog 1.—This animal was depressed and "off its food" for two days. It was at this time markedly icteric. The temperature, 101·4° F., fell gradually until death, which took place on the fifth day.

Post-mortem.—The pup died on its way to the laboratory. Post-mortem examination half an hour after death. Marked general jaundice. The peritoneal cavity contained a small quantity of blood-stained fluid. The *intestines* showed large areas of inflammation, especially in the jejunum and ileum, the contents being mixed with blood. Intussusception of the jejunum present. *Liver* congested and gall bladder full of bile; the duodenum in close proximity to the gall bladder was bile-stained. *Kidneys, spleen, suprarenals, and pancreas*

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appeared normal. Ali *mesenteric glands* enlarged, congested, and showed small punctate hæmorrhages. Most of the lymphatic glands were in a similar condition, specially the sublumbar and mediastinal group. *Lungs* showed a typical " butterfly wing " appearance.

Ground-up liver showed sparse but unmistakable leptospiræ. Three guinea-pigs inoculated with ground-up liver did not develop jaundice ; they died over a month after inoculation, and no leptospiræ were seen in any of their tissues.

Levaditi sections of the various tissues showed no leptospiræ.

Dog 2.—When first examined this pup showed great depression, vomiting, conjunctivitis, and passed liquid stools containing specks of blood and mucus. Temperature 102·5° F. Jaundice on the fourth day. On the seventh day an intussusception was palpable. Death on the eighth day.

Post-mortem.—Post-mortem two hours after death. Lesions practically identical with those of Dog 1, except that lungs were not so typical. A few fresh petechiæ were seen along the margins of the lungs. Smears made from ground-up liver, spleen, kidneys, and glands showed no leptospiræ. Inoculated guinea-pigs developed typical leptospiral infection. Levaditi-stained sections of mesenteric glands showed typical leptospiræ.

Dog 3.—This puppy became suddenly ill with slight rigors, great depression, anorexia, thirst, constipation, vomiting, with some blood in the mucous vomitus, and severe photophobia. Conjunctivitis on the third day. Temperature gradually fell from 103·5° F. on the days of onset to 101·2° F. on the fourth day. Jaundice well marked on this day, and increased in intensity to the seventh day. Clay-coloured and blood-stained fæces passed. On the seventh day intussusception was palpated. The puppy collapsed on the seventh day, the temperature then being 97° F.

Post-mortem.—Autopsy carried out immediately after death ; there was marked general icterus, hæmorrhage into both *lungs* giving a " butterfly wing " appearance. Hæmorrhages into the *thymus gland, pleura, pericardium.* Slight effusion of serous fluid into *mediastinum. Thoracic lymphatic glands* enlarged and very congested. *Liver* enlarged and pale. *Stomach* appeared normal externally, but when opened distinct submucous hæmorrhages seen and contents blood-stained. *Pylorus,* submucous hæmorrhages. *Jejunum and ileum* showed many submucous hæmorrhages, and an intussusception was found at the first part of the ileum. *Large intestine* showed several discrete hæmorrhages near the cæcum. *Abdominal lymphatic glands* markedly congested and hæmorrhagic. There were a few discrete hæmorrhages in the *peritoneum. Spleen*

and pancreas appeared normal. *Kidneys* enlarged and slightly congested, and there were several small hæmorrhages into the cortex. Bladder contained highly albuminous urine. The ground-up liver showed several undoubted leptospiræ. Cultures of liver positive for leptospira. Inoculated guinea-pigs died with typical lesions.

A dog (Exp. Dog 5) was also inoculated.

Dog 4.—This was an adult dog about four years old and had been ill several days. It had vomited freely, and had become jaundiced two days before we examined it. Jaundice was general, pulse 84 and weak, temperature 98·6° F. The dog lay absolutely still, paying no attention to its surroundings. The bowels did not move, and it died suddenly.

Post-mortem.—Post-mortem immediately after death. Jaundice intense and general. Lesions in *lungs* and *lymphatic glands* were typical. *Stomach* and *intestines* appeared normal. Leptospiræ could not be isolated from this case.

Dog 6.—This pup showed depression, vomiting, thirst, and intense conjunctivitis when first seen. Temperature 102·4° F. Slight jaundice was noted on the fourth day, the day of its death.

Post-mortem.—Post-mortem immediately after death. Slight jaundice was present and catarrhal discharge from nose and eyes. The picture was similar to that seen in Dog 1, except that fewer hæmorrhages were present. *Lymphatic glands* congested but not hæmorrhagic, and lungs typical.

Ground-up liver showed definite leptospiræ. Inoculated guinea-pigs died three weeks later with hæmorrhagic symptoms but no jaundice, and no leptospiræ were seen in their tissues. One dog (Exp. Dog 12) was inoculated with ground-up liver.

Dog 7.—Pieces of liver, kidneys, and lungs only were received. The material was stated to have come from a beagle puppy aged three months which died of " Distemper with Jaundice."

Lungs typical. Leptospiræ could not be isolated.

Dog 8.—This pup showed great depression. Manipulation of the neck and abdomen caused pain. Temperature 104·2° F. Pulse rapid and weak. Constipation. Slight conjunctivitis. Bronchial râles were well marked and there was a soft cough. Complete anorexia. Second day, the temperature was 102·2° F., and hæmorrhagic herpes of the lips appeared. Cervical glands swollen. Jaundice marked. Temperature sank rapidly during the next six hours, gums bled, and blood was passed per rectum.

Post-mortem.—Autopsy within two hours of death. Jaundice intense and general. *Liver* enlarged and congested. *Spleen* was enlarged. *Lymphatic glands* much enlarged, highly congested, and

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hæmorrhagic. *Kidneys* pale. Hæmorrhages in *lungs, pleura,* and *peritoneum. Mediastinum* contained a sero-fibrinous exudate. There were tracts of acute congestion in both *small* and *large intestine.* No leptospiræ were found in this case.

Two dogs (Exp. Dogs 13 and 14) were also inoculated.

Dog 9.—This pup died after a few hours' illness. No jaundice observed.

Post-mortem.—Hæmorrhages in the *lungs, pleura, and peritoneum. Lymphatic glands* congested and enlarged. *Spleen* appeared normal. *Kidneys* apparently enlarged. Petechiæ present in *stomach* and *small intestine.* No leptospiræ were found on direct examination of tissues. Inoculated guinea-pigs developed jaundice and died. Typical lesions were found and leptospiræ were isolated. Exp. Dog 17 was inoculated from this strain.

Dog 10.—History similar to that of Dog 9.

Post-mortem.—No jaundice. *Liver* irregularly mottled. A few hæmorrhages present in *lungs* and *pleura.* Abdominal cavity contained about 50 c.c. of a blood-stained fluid. *Large intestine* congested throughout. All *lymphatic glands* were enlarged and congested. No leptospiræ demonstrable on direct examination. Inoculated guinea-pigs remained healthy.

Dogs experimentally infected with Leptospira of Canine Origin.

Exp. Dog 2.—(Passage Dog 2 through guinea-pig to Exp. Dog 2). Inoculated September 25, 1924, intraperitoneally with 2 c.c. ground-up guinea-pig liver. Typical jaundice, October 10, 1924. Stools blood-stained. Temperature dropped to 98·6° F. from 103° F., and great depression was noted. Jaundice disappeared and pup gradually recovered. It was destroyed for examination on October 27, 1924.

Post-mortem.—No jaundice remained. In the *lungs* were several old punctate hæmorrhages. Other tissues normal. No leptospiræ in *liver,* but in *kidney* there were many definite leptospiræ, and the urine apparently contained dead forms. Guinea-pigs inoculated from kidney remained normal.

Exp. Dog 3.—(Passage Dog 2 through guinea-pig to Exp. Dog 3). This pup was inoculated as Exp. Dog 2. It developed jaundice, discharge from eyes and nose, constipation, and later passed clay-coloured stools showing streaks of blood and mucus. Temperature dropped from 102° F. to 100·8° F. before death. Great depression and wasting were noted. It was destroyed when *in extremis* on October 4, 1924.

Post-mortem.—Icterus intense and general. *Lungs* typical.

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Lymphatic glands enlarged and hæmorrhagic. *Liver* enlarged and pale. Hæmorrhages in *intestines*. An intussusception in *ileum*. No leptospiræ could be isolated from this case.

Exp. Dog 4.—(Passage Dog 2 through guinea-pig to culture to Exp. Dog 4). Inoculated September 30, 1924, intraperitoneally with 1 c.c. culture grown from liver of infected guinea-pig. Pup appeared well until October 3, 1924, when the temperature rose to 101·8° F. Anorexia, soft cough, catarrhal discharge from nose and eyes, and constipation. On October 4, 1924, the temperature began to fall and slight jaundice was evident. Jaundice became intense: clay-coloured stools were passed. Depression marked and pain on manipulation. Death occurred on October 8, 1924.

Post-mortem.—Jaundice intense and general. *Lungs* typical. *Intestines* congested in parts. *Lymphatic glands* enlarged and hæmorrhagic. Leptospiræ found in the ground-up lungs and kidneys, but not in liver. Guinea-pigs inoculated with ground-up liver died typically, and leptospiræ found in their livers.

Exp. Dog 5.—(Passage Dog 3 through culture to Exp. Dog 5). Inoculated September 30, 1924, intraperitoneally with 1 c.c. culture grown directly from liver of Dog 3. Pup developed the typical disease, temperature falling to 98·4° F. before death on October 9, 1924.

Post-mortem.—Jaundice intense and general. *Lungs* typical. *Lymphatic glands* hæmorrhagic. *Liver* enlarged and congested. *Intestines* congested. Questionable forms resembling leptospiræ only seen.

Exp. Dog 6.—(Passage Dog 4 direct to Exp. Dog 6). Inoculated October 1, 1924, intraperitoneally with 4 c.c. ground-up liver and spleen of Dog 4. This dog, aged about nine months, has never shown any signs of disease and is still healthy. (December 12, 1924).

Exp. Dog 7.—(Passage Dog 2 through guinea-pig, through Exp. Dog 3 to Exp. Dog 7). Inoculated October 4, 1924, 4 c.c. ground-up liver Exp. Dog 3 intraperitoneally. Pup perfectly healthy till October 16, 1924, when blood was seen in the stools. Jaundice developed the same evening and temperature began to fall. Death on October 17, 1924, the temperature being 99·6° F.

Post-mortem.—Jaundice intense and general. *Liver* pale. *Spleen* congested and enlarged. *Large and small intestines* showed numerous punctate subserous hæmorrhages. Two intussusceptions were present. *Lungs* typical. Leptospiræ could not be demonstrated in this dog after death by direct methods, but a guinea-pig inoculated with ground-up liver died typically with numerous leptospiræ in the liver.

Exp. Dog 12.—(Passage Dog 6 direct to Exp. Dog 12). Inocu-

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lated intraperitoneally with 3 c.c. ground-up liver Dog 6, October 9, 1924. This pup did not develop clinical symptoms of disease, and when destroyed on October 31, 1924, was apparently healthy. The post-mortem examination showed no evidence of disease.

Exp. Dog 13.—(Passage Dog 8 direct to Exp. Dog 13). Inoculated 2 c.c. mixture of ground-up organs of Dog 8 intraperitoneally October 29, 1924. Pup remained healthy till November 4, 1924, when it refused food, developed a thin watery discharge from nose and eyes, and suffered from diarrhœa with blood in the motions. Its temperature fell from 100·8° F. to 95·2° F. in twenty-four hours. No jaundice was evident. Death occurred on October 5, 1924.

Post-mortem.—No jaundice. *Liver* congested. Gall-bladder full of dark bile. The whole *intestine* markedly inflamed. Two intussusceptions were present. Mesenteric, sublumbar, and bronchial *lymphatic glands* enlarged and congested. *Lungs* showed six small fresh hæmorrhagic spots and four larger discrete similar areas near their borders. No leptospiræ were found. Guinea-pigs were not inoculated.

Exp. Dog 17.—(Passage Dog 9 through guinea-pig to Exp. Dog 17). Inoculated 0·25 c.c. ground-up guinea-pig liver intraperitoneally October 31, 1924. This pup appeared perfectly healthy till the evening of November 14, 1924, when its temperature was 102·6° F., and a thin discharge was observed from its nose and eyes. Food was refused. On November 15, 1924, marked jaundice developed, and the temperature was 100·2° F. The pup was killed.

Post-mortem.—Jaundice intense and general. *Lungs* typical. A sero-fibrinous exudate was present in the *mediastinum*. *Liver* congested and gall-bladder full. There were areas of congestion on *stomach* and *intestines*. No intussusceptions were present. Mesenteric *lymphatic glands* much enlarged and hæmorrhagic. Leptospiræ seen in the blood and ground-up liver. Guinea-pigs inoculated intraperitoneally with blood and with ground-up liver died from a typical leptospiral infection, and leptospiræ were found in their various organs.

Exp. Dog 18.—(Passage Dog 9 through guinea-pig to Exp. Dog 18). Inoculation, history, post-mortem, and results identical with those of Exp. Dog 17.

Dogs experimentally infected with Leptospira of Rat Origin.

Exp. Dog 1.—Inoculated intraperitoneally with 1 c.c. of ground-up liver from a guinea-pig dead of leptospira infection (Rat 2 leptospira) September 18, 1924.

The first signs of illness were noted on September 23, 1924, when icterus appeared in the usual situations. Constipation was marked, and this later gave place to diarrhœa, the stools being clay-coloured and streaked with blood. Great depression was noted and pain evinced on handling. There was a discharge from the eyes and nose. The pup was killed by chloroform on September 24, 1924. Temperature taken daily showed a rise on September 22, 1924 to 102·2° F. and a rapid fall before death to 99·6 F.

Post-mortem.—Jaundice intense and general. *Lungs* typical. *Intestines* showed punctate hæmorrhages, especially in the *duodenum* and *rectum*. Leptospiræ found with difficulty in the ground-up liver.

Exp. Dog 15.—Inoculated with 2 c.c. as Exp. Dog 1 on November 4, 1924. No signs of illness were observed until November 9, 1924, when slight jaundice developed. The course was then similar to that of Exp. Dog 1.

Post-mortem.—Jaundice intense and general. *Lungs* typical. The *peritoneal cavity* contained about 5 c.c. of hæmorrhagic fluid. Two intussusceptions were noted. *Small intestine* showed punctate hæmorrhages. *Lymphatic glands* enlarged and congested, many showing hæmorrhages in their substance. The *mediastinum* contained a sero-fibrinous exudate. Leptospiræ present in liver.

Exp. Dog 16.—Inoculation as in Exp. Dog 15 on November 4, 1924. On November 10, 1924, food was refused and blood passed in a clay-coloured semi-solid stool. At the same time jaundice developed. Depression extreme. The evening temperature was 95° F. Dog found dead on November 10, 1924.

Post-mortem.—Jaundice intense and general. *Lungs* typical. Extensive hæmorrhages into the *abdominal wall*. *Intestines* highly inflamed. Intussusception of jejunum. *Lymphatic glands* enlarged and hæmorrhagic. *Mediastinum* contained a sero-fibrinous exudate. Leptospiræ were seen in the *liver*.

We have received a number of illustrations and charts which we are pleased to publish in full detail, in completion of this important piece of original research.

We feel sure that their extreme importance will be equally recognised alike by members of the human and veterinary branches of comparative medicine as a further instance of the value of collaboration between workers in human and animal pathology.

It is an instance, too, of what can be done for veterinary pathology and bacteriology if only opportunity for original research is given to those of our graduates whose aptitude lies in the direction of laboratory work; provided they unselfishly collaborate with their clinical colleagues in the field.—EDITOR, VETERINARY JOURNAL.

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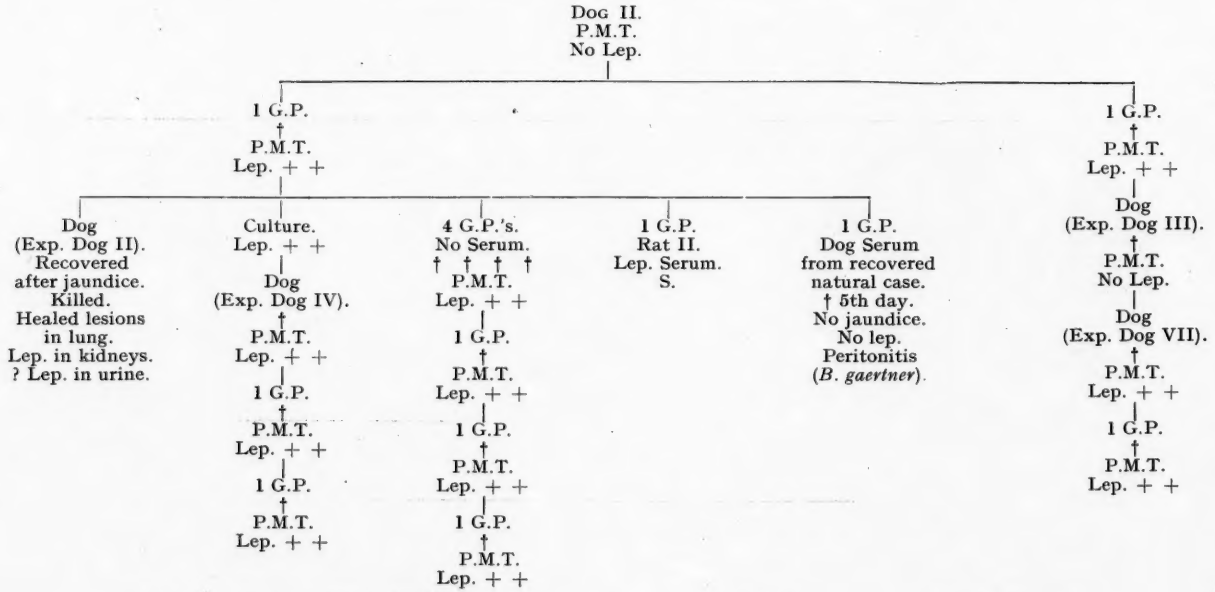
FIG. 1.—Ground-up Liver of Guinea-pig showing Living Leptospira from a Case of Canine Jaundice (Dog 9). Dark-ground illumination. Magn. × 1300.

FIG. 2.—Section of Sublumbar Lymphatic Gland of a Dog affected with Canine Jaundice showing Leptospiræ (Dog 3). Dobell's modification of Levaditi's method. Magn. × 1300.

CHART I.

PASSAGE TREE OF DOG II LEPTOSPIRA.

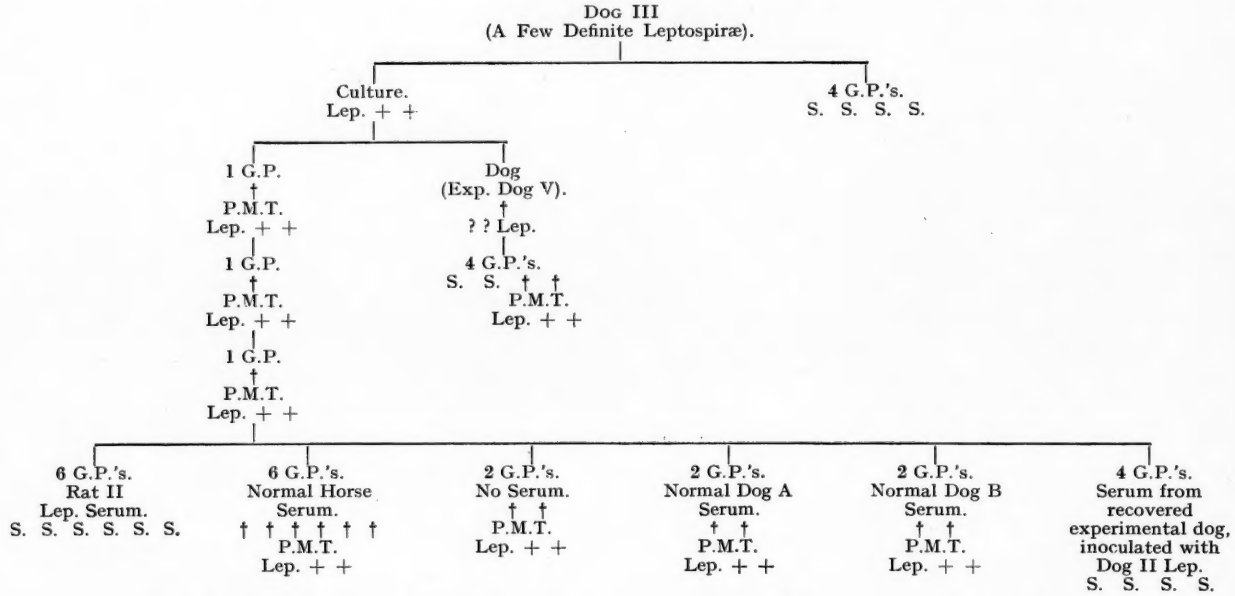


P.M.T. = Typical post-mortem appearances.
Lep. + + = Many leptospiræ present.

† = Died. G.P. = Guinea-pig.
S. = Animal survived with no symptoms.

CHART II.

PASSAGE TREE OF DOG III LEPTOSPIRA.



P.M.T. = Typical post-mortem appearances.
Lep. + + = Many leptospiræ present.

† = Died. G.P. = Guinea-pig.
S. = Animal survived with no symptoms.

CHART III

TITRATION OF SERUM OBTAINED FROM A HORSE IMMUNISED WITH RAT II LEPTOSPIRA STRAIN.

Amount of Serum	Guinea-pigs Injected	
1 c.c.	S	S
0·5 c.c.	S	S
0·4 c.c.	S	S
0·2 c.c.	S	†
0·1 c.c.	†	†
0·05 c.c.	†	†
0·025 c.c.	†	†

Two guinea-pigs on each dose of serum. Test dose of virus 1 c.c. of ground-up liver rich in leptospiræ, injected intraperitoneally.

S = Survived.
† = Died with typical signs of infection with leptospira.

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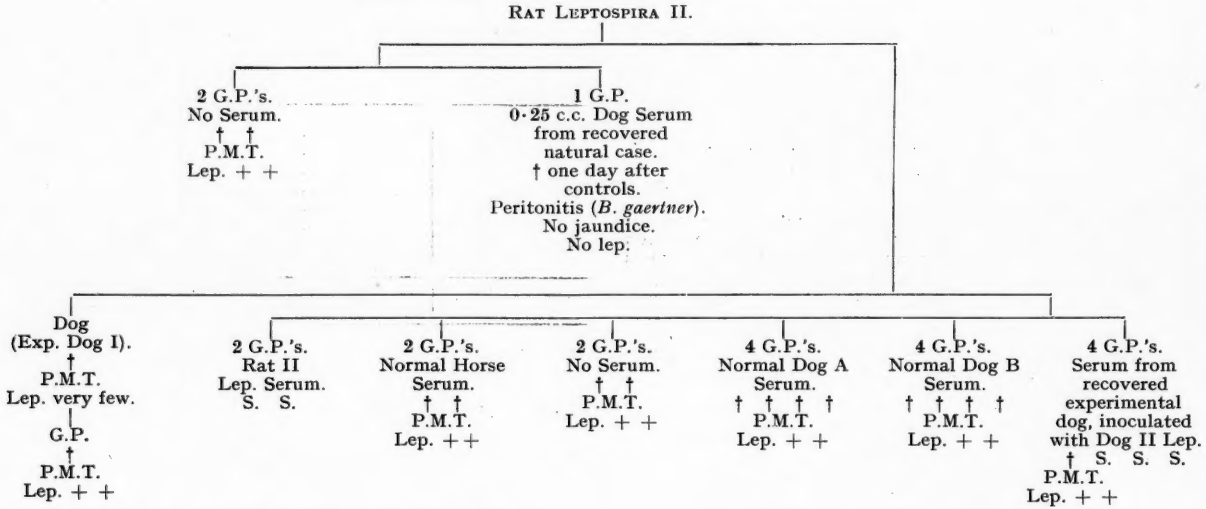
CHART IV.

PASSAGE TREE OF RAT LEPTOSPIRA STRAIN.



P.M.T. = Typical post-mortem appearances.
Lep. + + = Many leptospiræ present.

† = Died. G.P. = Guinea-pig.
S. = Animal survived with no symptoms.

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CHART V.

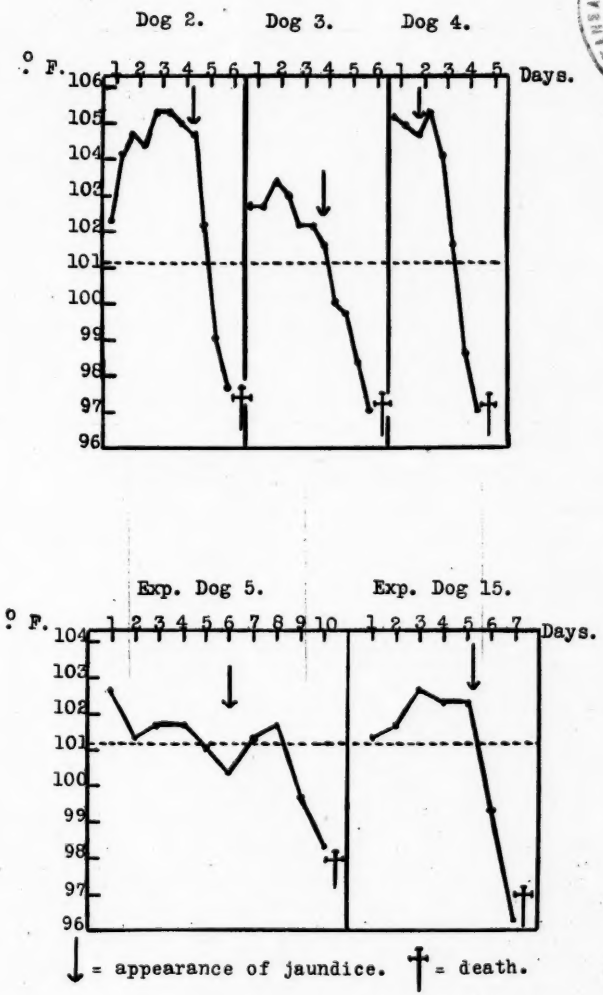

TABLE I.—SHOWING TIME OF OCCURRENCE OF JAUNDICE AND TIME OF DEATH AFTER ONSET IN NATURALLY OCCURRING CASES.

Dog.	Occurrence of Jaundice (Days).	Time of Death (Days).
1	2	5
2	4	6
3	4	7
4	2	5
6	4	4
8	2	3
9	None	1
10	None	1

TABLE II.—SHOWING TIME OF OCCURRENCE OF JAUNDICE AND TIME OF DEATH AFTER INJECTION IN DOGS ARTIFICIALLY INFECTED.

Dog.	Leptospira Strain.	Jaundice (Days).	Death (Days)
Ex. 2	Dog	16	Lived
Ex. 3	Dog	7	10
Ex. 4	Dog	5	10
Ex. 5	Dog	6	11
Ex. 7	Dog	6	13
Ex. 17	Dog	16	17
Ex. 18	Dog	16	18
Ex. 1	Rat	5	6
Ex. 15	Rat	5	6
Ex. 16	Rat	5	7

REFERENCES.

BALFOUR, A. 1922, Parasitology, xiv, p. 282.
BUCHANAN, G. 1924, Brit. Med. Jour., ii, p. 990.
COURMONT, J., and DURAND, P. 1917 (*a*), Compt. Rend. Soc. Biol., 79, p. 275.
COURMONT, J., and DURAND, P. 1917 (*b*), Ibid., 79, p. 277.
DAWSON, B., HUME, W. E., and BEDSON, S. P. 1917, Brit. Med. Jour., ii, p. 345.
GRAY, H. 1915, In Hoare's System of Veterinary Medicine, London, vol. i, p. 688.
GRIFFITH, A. S. 1919–20, Jour. Hyg., xviii, p. 59.
HOARE, E. WALLIS. 1915, A System of Veterinary Medicine, London, vol. ii, p. 580.
INADA, R., IDO, Y., HOKI, R., KANEKO, R., and ITO, H. 1916 (*a*), Jour. Exper. Med., 23, p. 377.
INADA, R., IDO, Y., HOKI, R., ITO, H., and WANI, H. 1916 (*b*), Ibid., 24, p. 485.
KŘIVÁČEK, O. 1924, Ztschr. für Hyg. und Infektionskrank, 103, p. 529.
KRUKENBERG. 1916, Quoted by Krumbein and Frieling.
KRUMBEIN, R., and FRIELING, B. 1916, Deut. Med. Woch., xlii, p. 564.
LEISHMAN, W. B. 1920, Lancet, ii, p. 1237.
LUKÊS, J. 1924, Ann. de l'Inst. Pasteur., xxxviii, p. 523.

MARTIN, L., and PETTIT, A. 1919, Spirochétose Ictérohémorrhagique, Paris (Masson), p. 242.
MONTI, A. 1917 (Quoted Martin et Pettit, 1919). Epidemiologia, patalogia e patogenesi della spirochetosi itterogena, 1 vol. in-8°, 88 p., 3 pl. doubles, tiré a part de ; Bolletino della Societa medico-chirurgica di Pavia.
NICOLLE, A., and LEBAILLY, C. 1918, Compt. Rend. Soc. Biol., lxxxi, p. 351.
NOGUCHI, H. 1924, Jour. Exper. Med., xxxii, p. 143.
OKELL, C. C., DALLING, T., and PUGH, L. P. 1924, Veterinary Record, iv, p. 1002.
STEVENSON, A. C. 1922, Amer. Jour. Tropical Med., ii, p. 77.
STOKES, A., RYLE, J. A., and TYTLER, W. H. 1917, Lancet, i, p. 142.
TOHYAMA, Y. 1924, Japan Med. World, iv, p. 193.
UHLENHUTH, P., and FROMME. 1919, Ztschr. für Immunitats. Orig., 1, p. 70.
VAN DE VELDE, E. 1923, Transactions of the Far Eastern Association of Tropical Medicine, p. 679.

FOOT-AND-MOUTH DISEASE IN GREAT BRITAIN EIGHTY-FIVE YEARS AGO.

BY MAJOR-GENERAL SIR FREDERICK SMITH, K.C.M.G., C.B.,
Fellow and Hon. Associate Royal College of Veterinary Surgeons.

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IN August 1839, a month after the death of Coleman, the cattle in a dairy farm at Islington were attacked with an eruption affecting the lips, tongue and feet, which was at first believed to be due to some deleterious substance in the pasture. As, however, some hundreds of cases occurred in the course of a few days, the poisonous plant theory was soon abandoned. Subsequent inquiries showed that the disease had broken out at East Sheen and Amersham as early as May of the same year, but no report appeared until September 1839, when Youatt published * an account of *The Present Epidemic Among Cattle*, from notes furnished him by Mr. Hill, veterinary surgeon of Islington, who had the superintendence of a dairy of 700 cows, among which the outbreak had occurred. Youatt does not appear to have seen the cases—he was confined to his room—nevertheless, the symptoms are well described. The communication is a brief matter-of-fact statement. Youatt had no notion that he was recording the outbreak of a plague which was to last at least three years and infect the whole of England and part of Scotland. He had no hesitation in assigning it to some atmospheric influence, and adds a paragraph to the effect that an old ulceration on his instep had increased in extent and tortured him to such a degree as almost to incapacitate him from mental exertion. Is this, he asks, connected with the same atmospheric influence ?

William Sewell, who had just succeeded Coleman as Professor in the London Veterinary School, was more than an energetic sup-

* *Veterinarian*, Vol. xii.

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porter of this theory of the aerial origin of epizootic diseases. He claimed that no ancient or modern author (other than himself) had previously penetrated the mystery of their origin. Yet he ought to have known that noxious emanations from the earth had been blamed for producing epizootics as early as the days of Virgil and Ovid. We must glance at Sewell's views, as practically the whole of the then members of the profession had passed through his hands, and he was still busy moulding the generation which succeeded them. In his oration on this subject, at the opening of the session of the Veterinary Medical Association 1837–8,* he tells us with the most perfect assurance that for 2,400 years after the creation of the earth disease was unknown, and men and giant animals lived to the age of 500–900 years! Then came a deluge (though rain and tempest had been previously unknown), the flood was intensified by "fountains" in the earth, 4,000 miles deep, which contributed to a mass of water which rose some miles above the earth. Finally the water subsided, the earth dried, and into the fountains were washed the decomposing remains of animal and vegetable matter, so that the interior of the earth became a vast cemetery. Giant animals and long-lived men disappeared, and the atmosphere became less pure. In the interior of the earth the decomposing remains gave rise to fire, and from exhalations within the globe originated all epidemic diseases!

Of all the men at this date who contributed to our knowledge of foot-and-mouth disease in this country, there were only two—both of them obscure country practitioners—who were bold enough to say that they disbelieved in atmospheric causes.

Following Youatt's article, during the remainder of the year 1839 extraordinarily little attention was paid to this disease, although it was steadily spreading to all points of the compass. Youatt's silence is difficult to explain, excepting on the grounds of ill-health, and that he was actively engaged in a struggle with the Governors to obtain better and extended teaching at the Veterinary College. There is only one contribution on the subject of the epizootic during the remainder of the year, from a Mr. Welton, a practitioner of Essex, who says, in the October number of the *Veterinarian*, that he has had sixty-three cases since August 1st. He gives a good account of the disease, and records that pigs suffer from it, and that some had in consequence lost their toes. He also noted the udder lesions in cows.

The year 1840 arrived, and on January 21st the disease was mentioned for the first time at the Veterinary Medical Association, London (then the centre of the intellectual activities of the pro-

* *Veterinarian*, Vol. xi.

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fession), when Duffield of Bungay wrote to say that the disease had appeared in his district in November 1839, and he was uncertain whether it was contagious. Hinds of Beccles reported the disease in his practice, cattle, sheep, and pigs being affected. But the best contribution to the meeting was made by Ernes, a London practitioner, who had been trained on the Continent. He gave an account of the epizootic as seen in France and Germany—a most valuable contribution. C. Spooner, who had recently been appointed to the staff of the school, in summing up the discussion, expressed the opinion that the disease in cattle resembled influenza in horses, that its origin was atmospheric, and further, it was quite distinct from foot-rot! In April 1840, Wardle of East Sheen wrote to the *Veterinarian* to say that he had forty cases of the disease, and would like to learn something of the affection. In May of the same year the Royal Agricultural Society addressed Sewell officially on the subject, and asked for his recommendations for arresting the progress of the epizootic. Sewell knew nothing of the diseases of any animal other than the horse, but instead of saying so, he furnished the Society with two pages of platitudes, recommended bleeding and the inevitable drench, and, if these failed, employment of an experienced veterinary surgeon.* *Sewell made no mention of isolating the affected*, but the Society, before issuing the circular to stock-owners, added this, doubtless on the initiative of Youatt, who was the active technical expert of that body.

Towards the end of the month of May 1840, a Dr. Gilmeister, of Bavaria, was introduced to a meeting of the Veterinary Medical Association, and gave an excellent account of the disease as it prevailed in Mecklenburg in 1838-9. Inoculation, he said, was practised by farmers, but he did not say with what results. He had seen swine affected, but not in the feet, nor had he witnessed the eruption on the teats and udders of cows. The disease appeared three days after the inoculation and was transmissible to man, as Hertwig had experienced in his own person through drinking warm milk. He definitely stated that *the disease was contagious and could always be communicated by the saliva.*

In June 1840 there were two or three communications to the

* This circular brought about a serious crisis in the profession. Earl Spencer, the most prominent member of the Royal Agricultural Society, stated at a public dinner at Liverpool that he was responsible for the circular, and that it had saved the farmer from the imposition of the "horse and cow doctor." Youatt's well-known connection with the R.A.S., and his zeal in writing popular educational works, led to his being regarded with suspicion. This suspicion was fostered by the London School, and Youatt became extremely unpopular; he says that he went in fear of lynching! As a matter of fact Youatt publicly condemned the Sewell-Spencer circular, and in 1842 he appears to have withdrawn from the Royal Agricultural Society.

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Veterinary Medical Association. One stated that Sonewing of Rugby had published a good paper on the subject of foot-and-mouth disease in the *Farmer's Magazine*.* Another said that a learned member of the Royal Agricultural Society (a doctor) attributed the disease to buttercups, and recommended the ploughing up of all pastures! The situation was relieved by an excellent communication from H. Lepper of Aylesbury, in which he described the symptoms and sequelæ of the disease; he recorded his inability to convey it to horses, and his difficulty in transmitting it experimentally to cattle. He noted that the vesicles were never under the tongue, that the teats were generally affected at the opening of the duct, and that mastitis might occur through the ducts being blocked by ulceration. The disease as it attacks the foot was carefully described, and he stated that foot lesions in swine were most severe. He said that the virulence of the disease grew weaker as the epizootic spread, and that the bulk of the animals remained unaffected. He did not find that inoculation gave protection, though two of his own cows inoculated from a vesicle did not contract the disease, not even when placed among the affected.

It was at this meeting that Morton, who knew nothing of foot-and-mouth disease excepting what he had gathered from the papers read, proposed that it should be called *Eczema Epizootica*, a name which it has since retained.

In July 1840, Tombs of Pershore (Worcestershire) † records that *Blain* had made its appearance in his district in April, the animals having been purchased at Tewkesbury in March. He notes that of the sucking calves only one was affected, though all were fed by infected cows. He asks whether the butter from such animals is infective. In the same number of the *Veterinarian* are extracts from the *Farmer's Magazine*, one from a clerical correspondent, who held the malady to be infectious and contagious, and says he inoculated with the affected saliva and produced the disease in a mild form. In December 1840, Read of Crediton recorded that the "pestiferous" epizootic had not yet reached his district. This is strange, for as a matter of fact by the end of 1840 the country was affected from Cornwall to Edinburgh.

With one or two exceptions—Lepper of Aylesbury being the most conspicuous—the information gathered in this country during 1840 does not redound to the credit of the profession. Even the question of contagion was not settled.‡ The College came out of the

* No volume quoted. † *Veterinarian*, Vol. xiii.

‡ Steel (*Diseases of the Ox*) says that Simonds proved the infectivity of the saliva in 1839 by feeding oxen with contaminated hay, and pigs with warm milk from an infected cow. There is no record of these experiments, and Steel does not quote his authority.

discussions badly. Youatt was not energetic, the only excuses which can be made for his supine attitude being his continued state of ill-health, his retirement from active practice, and the labours expended by him during this year in his tremendous fight to secure a Charter for the profession.

The year 1841, however, found Youatt roused into activity. In order to gather knowledge of the "epidemic," as he persistently calls it, he published in the *Veterinarian* for January a list of nineteen questions on which information was desired, and begged of the profession to send him replies. He toured the country in search of health, not omitting at the same time to seek for information. Replies began to come in the following month, the most notable being furnished by H. Lepper of Aylesbury, who again not only gave an admirable account of the disease, but supplemented it by statistical data of the 915 cases he had attended. This shows what a busy practitioner can do! Lepper pointed out the destructive effects of mammitis as a sequel to the disease; he described the gross changes occurring in the foot; he now had no doubt of the contagious nature of the affection, and said that he had never witnessed a second attack. Karkeek of Truro, another man of great ability, recorded that not only was the disease highly contagious, but that he had treated a young farmer who had contracted it from his affected animals. Dick of Edinburgh described the disease as mild; he said he had consumed affected milk without ill results; he regarded the malady as a form of "slight influenza," and non-contagious; infection of the udder he recognised as being serious. His contribution is not satisfactory, but he had very little personal knowledge of the disease, for he was essentially a city practitioner. In the month of February 1841 the Royal Agricultural Society adopted Youatt's plan of issuing a circular to stock-owners with the object of collecting information; thirty-two questions were drawn up with the aid of Sewell, and in due course some 700 replies were received. In connection with Youatt's circular, J. and G. Hawthorn of Kettering recorded a fresh symptom in some cases, i.e. ulceration at the base of the horns. Carlisle of Wigton, with his usual acumen, gave an admirable account of the disease, and was the first to draw attention to its liability to be spread by veterinary surgeons, attendants, butchers, and others in contact with animals, also by healthy animals walking over affected roads. He had vaccinated 100 cases, and thought that the resulting attack was milder. He had personally attended 1,000 cases; had seen calves born affected, and noted that parturient cows did badly. Farrow of Durham drew attention to a symptom not previously recorded. He said that prior to the appearance of disease

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developing there was a marked itching of the skin.* Though a firm believer in the contagious nature of the disease, he records that not one farm in twenty had been attacked. He pointed out that the infection was spread by markets, and that it was not until the great fair held at Newcastle on October 29, 1840, the largest in the North, that the epizootic could be said to have begun in that part of England; he also noted that by the following spring it had died away. Cleaver of Darlington stated that the farmers thought so little of the disease that they turned their new stock among affected animals in order "to get done with it." He had never seen a second attack, but reported the case of a horse being affected! Holmes of Thirsk said the disease began in his locality in June 1840, and he added that by common consent it was agreed that Irish stock had introduced it into Yorkshire.

In 1842 Sewell published in the *Journal of the Royal Agricultural Society* an account of the epizootic as extracted from the 700 replies received by that body. Poultry, cats, dogs, and deer were reported to have been affected. One correspondent stated that he and his family were attacked through using the milk. Sheep were reported to be more commonly affected in the feet, pigs in both mouth and feet. Dairy stock suffered from mammitis; pregnant cows were least affected; recently calved cows were violently attacked; abortion seldom occurred. There were a few records of second attacks, and a third attack was mentioned. Youatt considered Sewell's analysis of the large amount of material so unsatisfactory that he got the R.A.S. to place at his disposal all the reports of the 1841 outbreak, and gave in several subsequent issues of the *Veterinarian* a detailed account of the same. As usual, the evidence in these documents was very contradictory, but there were many records to show how lightly the disease dealt with some farms, and how frequently animals escaped infection under conditions which should have ensured their contracting it. Another point brought out was the frequency with which calves escaped though suckled by affected cows. The great benefits conferred by thorough isolation were evident, but many owners thought so lightly of the affection as to deliberately infect their whole stock. The eruption in cattle was sometimes noted as beginning in the feet; several observers reported the feet of sheep as being more commonly affected than the mouth. Pigs are sometimes recorded as the first animals to be attacked, and infected milk as a source of disease to these animals was fully recognised. The feet, in the case of pigs, are frequently referred to as the part chiefly

* Among the replies received by the R.A.S., two stock-owners describe their cattle as being affected with a skin eruption after convalescence; one observer states that the animals were spotted all over like a leopard.

attacked. The majority of the observers agree that no second attack appeared, but there are two exceptions noted in the case of sheep and one in a heifer.

The year 1843 Wyett of Painswick reported in the *Veterinarian* that a surgeon who attended his family examined affected cattle, and in consequence suffered from fever, inflammation of the roots of the nails of both fingers and toes, and subsequently lost two nails from the hand. Youatt adds a footnote, saying that he is losing the nail of the left forefinger owing to a sore, the result of contact with a diseased mouth, and that he had suffered considerable irritation and fever. In June a paper on foot-and-mouth disease in France and Switzerland was published in the *Veterinarian* after Hertwig, who said it was reported that inoculation would protect sheep, and that it was first practised by Brauell of Weimar in 1815.

Just at this time a "new epidemic," "quite different from that lately prevailing," was reported as "raging in Ireland" among horses and cattle. But it is not until the August number of the *Veterinarian* for 1843 that we learn from the pen of John Barlow that a disease was present among cattle near Manchester and had broken out at the beginning of the year. He gives an admirable clinical account and post-mortem appearances; he says the disease is almost invariably fatal, and asks for advice. This epizootic was *Pleuro-pneumonia*, the ravages and mortality from which appear to have diverted all further interest from foot-and-mouth disease, which by now had nearly worn itself out.

The first outbreak of foot-and-mouth disease in England lasted at least three years, and during the whole of that time all control was left to private enterprise. Youatt never once refers to any action taken by the Government. At this time, fortunately, the railways were few, and so far as I can learn carried no stock; nevertheless, the whole country was infected in a year by natural means. As we have seen, we cannot look back on the first epizootic with which the veterinary profession in this country had to deal with anything like pride in our profession. The fact is that with few exceptions no one knew anything about cattle, sheep, and swine. So far as the London School was concerned no animal other than the horse existed, and it was to rectify this and cause the pathology of the other animals of the farm to be taught that Youatt, with the Royal Agricultural Society behind him, fought the governing body, Coleman, and subsequently Sewell, and finally beat them, but not until foot-and-mouth disease had secured a firm hold in this country. Another, and perhaps the most important, explanation of the failure of the profession to grapple seriously with foot-and-mouth disease

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was the imperfect training of the London graduates. Had the groundwork of their teaching been solid, it would not have been long before adjustment could have been effected, in spite of their unfamiliarity with the classes of animal attacked. Coleman, however, had reduced the period of school-training to a few months; he allowed, and actually encouraged, the most undesirable class of man to enter the profession, and so ignorant were they of pathology, it is not surprising to learn that when Pleuro-pneumonia broke out it was regarded by many as an aggravation of foot-and-mouth disease! *

To the epizoctiologist the most striking feature of the first invasion of this country by foot-and-mouth disease is the great delay in recognising the contagious nature of the affection,† even William Dick dying unrepentant! It is not too clear that Youatt was a contagionist during the first year or two. The experiment attributed to Simonds in 1839 cannot be accepted until a record of it can be found. It was only the general practitioner of experience—for example, Lepper of Aylesbury, Carlisle of Wigton, Karkeek of Truro—who had no doubt as to the contagious nature of foot-and-mouth disease. Stock-owners generally recognised it as contagious, some, as we have seen, deliberately infecting their whole stock as the quickest way of getting rid of the trouble.

There must be some explanation of this remarkable fact, and the question arises whether the disease was really as virulent in 1839–43 as it proved to be in subsequent outbreaks? In this connection we advert to the following points already noted: The large number of farms which escaped, in spite of the disease being around them, and little if any care taken to prevent the carrying of infection; over and over again animals, young and old, in direct contact with the diseased escaped infection; the ease with which isolation on farms, imperfect as we may suppose this to have been, prevented the affection from spreading. Finally, Dick and others speak of the disease as mild, or note that in time it appeared to become milder.

* In case it may be thought that I have exaggerated the position, I give the following extract (written seventy years ago) from the pen of one (Morton), who was for years at the London School, from the time of Coleman onwards :—

"While we lament with unfeigned sorrow the slow progress that has been made, we yet rejoice that we can by comparing the past with the present still give reason for joy and hope; for who among us capable of looking back for a period of thirty or more years, but must remember with shame and disgust the mode in which young men were sent forth into the world certified as 'fit to practise the veterinary art in all its branches'; many of them manufactured out of the really raw material without the least pretension to even a common education, to many of whom their own written names were almost mysteries, and whose authography and penmanship would have disgraced the lowest pupil in a parish school of the present day. . . ."—*Veterinarian*, Vol. xxviii., 1855.

† We have seen Gilmeister's definite statement on this point in May 1840.

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Clinical Articles

NOTES ON TWO UNUSUAL CRYPTORCHID CASES.

By Major W. ASCOTT, O.B.E., M.R.C.V.S.,
Bideford.

1. *June* 4, 1924.—Operated on in consultation with Mr. Percy Penhale, M.R.C.V.S., Barnstaple.

Subject, a three-year-old shire which had had one testicle removed as a yearling by Mr. Penhale, but it was not remembered which. Examination before and after casting revealed nothing definite. As the scar traversed the median line it was of little use as a guide, but as the right side appeared to be a little fuller than the left, and as we also thought we could detect the cord of the removed testicle, we decided to operate on the left side. Finding nothing in the inguinal canal, I entered the abdominal cavity and explored it without success for some considerable time, but then discovered I had missed a cord in or near the canal, although I thought I had explored it very carefully at the commencement. The cord was covered with its tunics, and at first we thought it was the stump of the testicle which had been removed as a yearling, but on a closer examination we decided it was a degenerated testicle. However, to make quite sure, I opened up the other side, and found an undoubted stump. It commenced to rain heavily soon after the operation was started, and we were rather nervous as to the efficacy of the continual swabbing of the rain-saturated skin around the wound ; but the colt made an uneventful recovery, and has since lost his " rigging " propensity.

2. *October* 20, 1924.—Operated on in consultation with Mr. R. E. L. Penhale, M.R.C.V.S., Torrington.

Subject, a two-year-old shire not previously operated on, the right testicle being very well developed, but the left missing. On entering the abdominal cavity with two fingers the cord was immediately found, but the opening had to be enlarged before the testicle could be coaxed out. At first sight it looked more like a large loop of bowel than a testicle, and had it not been for the evidence of the cord, should have been a bit puzzled to say what it was. There was an external sac which was large enough to hold a pint of fluid, but which actually only contained about two table-spoonfuls of sebaceous material. The walls were thick and wrinkled (like the bowel in Johnes disease), and inside, attached to the cord, was another sac about the size of an egg, containing hair, etc.

The colt did very well, and, except for the character of the testicle, there was nothing out of the ordinary in the operation.

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A USEFUL CLINICAL TEST IN CASES OF PLEURISY WITH EFFUSION.

By C. WENTWORTH ELAM, M.R.C.V.S., D.V.H.,
Liverpool.

THE diagnosis of a case of pleurisy with effusion is doubtlessly quite a simple matter, yet there is a simple test which can be applied, and is always very helpful.

In such cases, if traction is put on the long hairs of the mane and particularly those of the tail, it will be found that they come out quite easily, whereas in cases of pneumonia or pleurisy without effusion such is not the case. The degree of traction necessary to release the hairs varies with the amount of fluid present in the thorax. My experience is that at the commencement, when the effusion is just forming, and at the termination when the last of the effusion is being absorbed, greater traction is required than when marked effusion is present.

AN UNUSUALLY LARGE HÆMATOMA.

By FRANK CHAMBERS, O.B.E., F.R.C.V.S.,
Wolverhampton.

IN August of this year I was asked to look at a cow that had a very much enlarged quarter; and, as the milk appeared normal, the owner was afraid of tuberculosis.

As far as I could gather the cow was normal at the morning's milking, but came up in the evening with a very much enlarged and painful off-hind quarter. In a few days the pain disappeared, but there was no reduction in the size of the swelling.

When I saw it there was no pain in the quarter, and no enlargement of the supramammary glands. The milk was normal, but as she was only two months off calving there was not a great deal of it. The swelling appeared to be pointing in one spot, and I made an exploratory puncture with a sterile needle to see what this enormous enlargement contained. Only blood serum came away, and I came to the conclusion that I had a hæmatoma to deal with. I enlarged the original puncture with a Symes knife, and liberated over two gallons of serum and blood-clots. The cavity was afterwards syringed out with very dilute Formalin and Caustic Soda solution, and healing took place in three weeks. To-day no evidence can be seen of the original injury.

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COW'S TRACHEAL RING IN THE ŒSOPHAGUS OF A DOG.

By J. W. CONCHIE, F.R.C.V.S.,
Kidderminster.

The patient was a bull bitch puppy, about six months old, brought to me one night with a large swelling in the œsophagus, near the entrance to the thorax.

Thinking that it was caused by a bone, I prepared for œsophagotomy, but before doing this I passed a probang.

To my astonishment there was no resistance offered at the site of the swelling, and the probang passed definitely into the stomach. I repeated this with the same result several times, and then passed a pair of curved forceps.

With these I managed to grasp a foreign body, and, after gentle manipulation, withdrew two tracheal rings of a bullock. Apparently they had become lodged in the œsophagus in such a way that my probang passed down through the lumen. After their withdrawal the patient gave no further trouble or cause for anxiety.

Abstracts of Current Literature

Miller, C. Philip, Jr.—Attempts to transmit Rheumatic Fever to Rabbits and Guinea-Pigs.—*The Journal of Experimental Medicine*, October 1, 1924.

Introduction.

The search for the etiological agent of rheumatic fever has occupied the attention of many investigators. Of the several micro-organisms ascribed to this rôle the *Streptococcus viridans* has taken the foremost position. But a number of unexplained objections have restrained the majority of workers from accepting this bacterium as the cause of the disease. Perhaps the most important objection is the failure of laboratory animals inoculated with the *Streptococcus viridans* to develop the characteristic pathological lesion of rheumatic myocarditis, the so-called submiliary nodule, or Aschoff body.

Experimental.

We have attempted to transmit rheumatic fever to rabbits and guinea-pigs by injecting them with various materials obtained from patients suffering with this disease. The materials selected were whole blood, serum, joint fluid, pleural fluid, throat washings, and tonsil tissue. Thus were included those body fluids easily available, which might rationally be assumed to contain the virus of the disease during its acute stage. The frequent association of tonsillitis with

rheumatic fever explains the use of throat washings and of tonsil tissue.

Practically all of these substances were obtained either before the patients had received anti-rheumatic medication, or after a sufficient time following the discontinuance of the treatment for its effect to have disappeared. The clinical data on the patients are given in Table I. In each protocol the relation to such medication has been noted.

METHODS.

The following inocula were used:

1. *Blood.*—The blood was withdrawn by venipuncture during the acute febrile state while the polyarthritis was still developing. In some instances serum was used, but in most the whole uncoagulated blood, usually drawn into a syringe which had been previously washed with a 10 per cent. solution of sodium citrate. In one experiment a three-day blood culture in broth was used.

2. *Joint Fluid.*—The fluid was aspirated from acutely inflamed joints, sometimes within a few hours after the onset of symptoms in the joint punctured. The earliest possible exudate was thus obtained. Anaerobic cultures of joint fluid made according to various modifications of the Smith-Noguchi method were also used for inoculation. Such cultures were always free from any demonstrable bacteria.

3. *Pleural Fluid.*—This was withdrawn during an acute pleurisy with effusion in a patient with rheumatic fever. Culture of this fluid showed no growth.

4. *Throat Washings.*—The patient's throat was rinsed with about 15 cc. of Ringer's solution. The washings were then filtered through a Berkefeld N filter, with suction from the house vacuum system. Cultures of the filtrates were always sterile.

5. *Tonsillar Material.*—The tonsils were removed from patients under gas-ether-chloroform anæsthesia. Within one hour the tonsils were minced until reduced to a pulp, which was suspended in sterile Ringer's solution and centrifuged at slow speed for a few minutes to remove the coarser particles. Some inoculations were made with the suspension in this state and some with the filtrate passed through a Berkefeld N candle. The filtrates were invariably sterile in ordinary media.

Transfer Inoculations.—The materials used for transfer inoculation were blood and a suspension of heart muscle and spleen. These suspensions were made by mincing the tissues, mixing the pulp in sterile Ringer's solution, and centrifuging a few minutes at slow speed to throw down the coarser particles. In one instance anaerobic Smith-Noguchi cultures (ascitic fluid-kidney tissue) of joint fluid of Rabbit H-63 (Series III) were used. The same general plan was followed for transfer injections as in the initial inoculation.

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Animals.—The animals employed were young, healthy guinea-pigs and rabbits. The guinea-pigs were always inoculated intraperitoneally, the rabbits intravenously into the ear veins with blood and joint fluid, but intraperitoneally, with all other inoculants. This was necessary because it was found that the intravenous injection of such materials as tonsil suspension invariably proved fatal within a few hours.

Subcutaneous inoculations were also made into the abdominal wall of both rabbits and guinea-pigs in order that any local reaction might be more easily observed and also with the hope that subcutaneous rheumatic nodules might be produced. A few intra-articular inoculations were made into the knee-joints of rabbits.

Clinical Observations on the Animals.—The animals were fed on a diet of hay, oats, bread, greens, and water. They were weighed daily. Their rectal temperatures were taken twice a day. It was early found necessary to sterilise the thermometers in lysol solution and alcohol to prevent the spread of any epidemic gastro-intestinal disease.

The animals were examined daily for evidence of arthritis, subcutaneous nodules, diarrhœa, snuffles, or any other signs of illness. X-rays were made of any suspicious joints in order to avoid mistaking a bone fracture for joint involvement.

Routine Autopsy Procedure.—The animals were killed by a blow on the occiput. The chest was opened aseptically and blood collected into a large capillary pipette from the heart or great vessels. This blood was cultured routinely in dextrose agar plates and deep tubes, and sometimes also in broth, and used for the inoculation of other animals as indicated in the tables. If inspection of the viscera suggested the possibility of pneumonia, pleuritis, pericarditis, or peritonitis, film preparations and cultures were made. If heart and spleen were to be used for the transfer inoculations, a piece of each was removed and placed in a sterile dish to be treated as described elsewhere. Pieces of the following organs were fixed for histological examination: heart, lung, spleen, liver, and kidney.

The skin of the animal was then removed and the skeletal musculature and joints dissected and carefully examined. Joints showing such abnormalities as increased fluid content, congestion, or swelling of the periarticular tissues were cultured and then fixed for future histological examination.

Histological Examination.—Tissues to be examined microscopically were fixed in either Zenker or Müller-formol, and a piece of the heart muscle was always fixed in absolute alcohol as well. Sections were cut in paraffin and stained with eosin-methylene blue or with hematoxylin and eosin (depending on the fixation). Sections of the heart were stained also with the Unna-Pappenheim methyl green-pyronine stain.

Controls.—Control animals, both rabbits and guinea-pigs, were

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inoculated with normal human serum and whole blood, joint fluid from a case of arthritis deformans, control culture media, normal rabbit blood, and suspension of normal rabbit heart and spleen. These animals as well as uninoculated ones were kept under identical conditions and were autopsied and examined with the same care.

Results.

Twenty-seven rabbits and fourteen guinea-pigs were inoculated according to the methods described with body fluids and tissues of patients suffering from rheumatic fever. Transfer inoculations, i.e. rabbit to rabbit or guinea-pig to guinea-pig, brought the total number of animals used in the experiments to sixty-seven rabbits and forty guinea-pigs. These transfer inoculations were systematically carried out in a number of series in spite of the absence of symptoms of disease because such negative evidence does not prove the non-existence of a virus in the body of the animal inoculated. It is well known that several passages may be necessary to adapt a virus to a new environment, and to render it parasitic and pathogenic for its new host species.

A definite arthritis occurred in only two animals.

Although these observations were unique in our entire series of experiments, they are of considerable interest. Non-bacterial arthritis does not occur spontaneously in healthy rabbits or guinea-pigs. The animals were in a good state of nutrition and had been gaining weight steadily until two or three days before the appearance of joint involvement. Trauma cannot be definitely ruled out, even though X-ray gave no evidence of injury to the hard parts.

A fairly common finding in both the rabbits and guinea-pigs was the presence of bright red petechial hæmorrhages into the synovial membranes of the joints and into the periarticular tissues. As they were found in uninoculated control animals, and as microscopic examination showed them to be fresh and devoid of any inflammatory reaction, they were thought to be agonal in origin.

Myocardial Lesions.—The microscopic examination of the hearts of all of the rabbits and guinea-pigs revealed the presence of myocardial lesions in a large percentage.

The lesions most commonly consisted of groups of lymphocytes to which were sometimes added endothelial leucocytes in varying proportions. Polymorphonuclear eosinophils and more or less mature connective tissue cells were not uncommon. Plasma cells, mast cells, and polymorphonuclear neutrophils were rather rare. The arrangement of the cells was not strikingly constant. The various types of cells seemed to be mixed together without order. The lesions tended to assume an elongated, irregularly elliptical shape, their long diameters

parallel to the adjacent muscle fibres. The more extensive lesions filled the spaces between a number of fibres. In such instances the muscle cells sometimes appeared normal and sometimes showed loss of striation. But evidences of necrosis were uniformly absent except in the hearts of rabbits which had had a terminal bacteremia.

The lesions were most frequently found in the myocardium of the papillary muscles and septum, less often in the walls of the ventricles, and only occasionally in the auricles. Some lesions occurred subendocardially and subepicardially. None was ever found in the valves.

In the rabbits the incidence of the myocardial lesions was roughly proportional to their ages, but this was not true for the guinea-pigs. As the exact ages of the animals were not known, their weights were used as approximate indexes of age. In these tables the animals have been separated into two groups, those which had been injected with human material (initial inoculation) and those which had been injected with transfer material from other animals of their own species (transfer inoculations).

This grouping is necessitated by the suspicion which naturally comes to mind that the lesions might have been the result of inoculations with foreign proteins, and be similar in nature to those described by Longcope, but that this is not the case is shown by our experiments.

The lesions occurred with equal frequency in animals receiving human material and in those receiving blood and tissue suspensions from animals of the same species, and cannot, therefore, be regarded as a response to the inoculation of foreign proteins.

Lesions in every way identical with those described were found in control animals, both inoculated and uninoculated.

Discussion.

With the exception of the two instances of outspoken arthritis already discussed, no evidence of successful transmission of rheumatic fever was encountered in these experiments. As has been mentioned, non-bacterial arthritis is not met with in healthy rabbits and guinea-pigs, and its occurrence in animals injected with material from patients with rheumatic fever is interesting and suggestive. But the presence of arthritis in those two animals does not justify the conclusion that they were infected with rheumatic fever.

The transmission of rheumatic fever to laboratory animals is an important problem, one which must not be abandoned, for on its solution may rest the elucidation of the etiology of the disease. Our failure to accomplish it does not convince us that the active agent was not present in some of the materials with which we were working. A more reasonable explanation for our failure seems to be the inability

of the agent to gain a foothold in the species of animal employed under the conditions of our experiments. And it is with the hope that other workers may be hereby stimulated to attack the problem that this report is published.

The microscopic lesions in the hearts of the inoculated animals are of particular interest for several reasons. They might have been mistaken for Aschoff bodies, for occasionally one was seen which on casual observation could have been passed as an Aschoff body, not typical, to be sure. But one might not expect the tissues of the rabbit or guinea-pig to react exactly as human tissues do to a human virus.

As lesions apparently identical were found in uninoculated control animals, one is forced to conclude that they occur spontaneously in rabbits and guinea-pigs. This point is dealt with in more detail in other communications. It is obvious, therefore, that when myocardial lesions are discovered in animals subjected to experimental inoculation great caution must be exercised in the interpretation of their significance. As a similar myocarditis was considered by de Vecchi and Natali to be proof of the production of experimental rheumatism in their rabbits, and comparable foci were ascribed by Herry to the action of an "*endotoxine rhumatismale*" from streptococci, we feel that the interpretation of these authors of the etiology and nature of the lesions found by them cannot be accepted without further proof.

SUMMARY.

In a series of attempts to transmit a virus from patients in the acute stages of rheumatic fever, twenty-seven rabbits and fourteen guinea-pigs were inoculated with one of the following materials: Whole blood, serum, joint fluid, pleural fluid, throat washings, suspensions of tonsil tissue. Subsequent transfer inoculations from animal to animal brought the total number of animals employed in the experiments to sixty-seven rabbits and forty guinea-pigs. Only two animals developed an acute non-bacterial arthritis. No other evidence of successful transmission of the disease was obtained.

In about one-half of the rabbits and two-thirds of the guinea-pigs myocardial lesions were encountered which consisted of interstitial accumulations of lymphocytes and endothelial cells. Similar lesions were found in control animals.

Camille Guérin.—Vaccination of Cattle against Tuberculosis and a New Method of Prophylaxis of Bovine Tuberculosis.

THE author discusses the great losses arising in various countries from the presence of bovine tuberculosis. He states that the total

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cattle population of France in 1920 was 12,757,720 head, and the number of tuberculous subjects was no less than 2,000,000. Great Britain is hardly less affected. The statistics published by Sheridan Delépine are very significant in this respect. Out of 100 animals less than one year old, 34 per cent. reacted to tuberculin. Of 100 animals one to two years old, 13·2 per cent. reacted to tuberculin. Of 100 animals two to three years old, 24·1 per cent. reacted to tuberculin, three to five years old, 23·5 per cent., and five to nine years old, 48·9 per cent.

It is interesting to compare these results with those in the human subject. Reactions to tuberculin ascend so rapidly with age that almost all adult subjects are found to be more or less infected with tubercle bacilli. Thus from 20 per cent. at from one to two years old to 89 per cent. beyond fifteen years old. The conditions of contamination in housed cows is comparable to that in human habitations, and if cattle live as long as mankind they would react to tuberculin in a similar proportion. Through losses in money and danger to human beings a stern fight against bovine tuberculosis has been going on for thirty years. Under the impulse of eminent men like Nocard in France and Bang in Denmark, and thanks to the discovery made of tuberculin, which is only a simple concentrated extract of cultures of tuberculosis, a veritable crusade in favour of the separation of sick from healthy animals has been embarked on. The separation of affected from healthy cattle by means of the tuberculin test called Bang's method has considerably diminished the number of cases of tuberculosis.

It is purposely that I write "diminished." In several cases, besides the difficulty under this method of obtaining in all cases disinfectable places, it is found that even under the best conditions certain animals, tested and segregated and kept where outside contagion has been avoided, manifest (after a variable time and often after calving) a positive reaction to a fresh injection of tuberculin. This is explained on Behring's principle that the greatest number of cases of tuberculosis in the adult result from an infection contracted in infancy from a sojourn in an infected *milieu*. Contamination is compatible with all the appearances of health, the tubercle bacilli passed into the organism continue to live a latent life without manifesting their presence, comparable to a foreign body non-irritant, and as a result well tolerated and not causing a positive reaction to tuberculin in these subjects. These considerations indicate that the systematic use of tuberculin is insufficient to assure us of complete success against tuberculosis.

You may ask why many subjects affected early in life, or at

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any period, do not die off rapidly when attacked by the terrible malady.

The answer to this question is of very great importance. It is a fact that the individual or animal that has absorbed some tubercle bacilli, and in which the intimate conjunction of these bacilli and its organism has brought about the positive reaction to tuberculin, this subject, I assert, carries in itself the essence of its cure and means for quite a long duration of its illness. That is why tuberculosis of man as well as of animals is a chronic type of illness often compatible during the whole of life with all the appearances of health. In animals of the bovine species it is easy to show whether this experience is well founded. The experience is even more conclusive than one hoped for. If one takes two cows, one of which has reacted to the tuberculin test, which implies that it carries more or less extensive lesions of tuberculosis, and the other does not react at this same test, indicating that it is healthy, and one inoculates on the same day into the blood of these two animals the same quantity of tubercle bacilli in a dose which ought to kill in a space of two months, one observes an extraordinary fact, namely that the cow which did not react, which was not tuberculous before, dies, with the normal delay, in a space of two months. On the contrary, the cow which was already tuberculous remains in good health, the inoculation makes no difference to it ; its anterior lesions have not even been aggravated, and with serenity it sees its neighbour die, without itself being inconvenienced in the least.

The conclusion, somewhat paradoxical as it may appear, is that, *" to resist tuberculosis it is necessary to be tuberculous," it is necessary to react to the tuberculin test.* Not only does a positive reaction show us that the animal tested is tuberculous, but it indicates to us that this animal is remarkably well placed to resist re-infections, or superadded infections. You will perhaps say that the remedy appears worse than the disease, but the point arises : Is it possible to confer artificially on these animals this faculty of reacting to tuberculin without the animals being tuberculous in the proper sense of the word ? This question may be answered in the *affirmative.* Protection is afforded by *vaccination* (just as in the case of anthrax, black leg, and swine erysipelas). Vaccination is carried out with an attenuated virus, of microbes of these diseases, made harmless by laboratory methods ; they are, in a word, *domesticated* and brought into service as the aids of agricultural economy. Inoculation of the virus into the blood by the veins is always difficult, and attended with results that do not make it very practicable. But by subcutaneous inoculation, as in other vaccinations, which we have undertaken with Monsieur Calmette, our tests with our tubercle bacilli have been harmless.

If one injects under the skin, in the fold of the dewlap, of a healthy bovine a small quantity of vaccine (2 to 5 milligrams), one observes no local reaction, and at no time does the animal react to the tuberculin test. It has acquired no immunity, as we have been able to establish. But if the dose of vaccine is much stronger (50 milligrams), one sees beneath the skin, twenty-four hours after, at the place of inoculation, a soft œdema, varying in size from a nut to a hen's egg. On the morrow this little lesion has become more compact, and has attained its maximum size. In the days which follow it increases only in consistence, and definitely shows itself as a small, hard mass, smooth and mobile under the skin; and if the injection has been pushed far enough the lesion does not adhere to the deep face of the skin. This vaccinal lesion diminishes in volume very slowly; always perceptible after six months, it tends to disappear from the tenth to the eighteenth month. It is always painless. If one submits such an animal to the tuberculin test, one sees that from the twentieth day after vaccination it reacts to tuberculin as if it was tuberculous; thus we consider the positive post-vaccinal reactions to tuberculin as the test of the maximum state of vaccination, comparable to that manifested by cattle already tuberculous, as shown by a virulent experimental inoculation.

This positive reaction to tuberculin persists in calves for at least six months after vaccination, then it tends to disappear slowly up to the twelfth month, almost at the same time as the lesion produced by vaccinal inoculation itself diminishes and disappears. The state of immunity does not disappear with the cessation of the reaction to tuberculin, but *the optima condition* declines and has a tendency to become weaker.

Besides showing that this practice of vaccination was harmless, we had to determine whether animals thus vaccinated were capable of resisting tuberculosis—in a word, that the practice was effective.

Tests have been made since 1921, and the vaccination has been found to be *simple, harmless, and effective.* It provides a surer way of prevention than by imperfect isolation and disinfection. Vaccination should not be practised in an infected *milieu.* By vaccinating calves under fifteen days old and annual revaccination, it is possible to clear out tuberculosis in a space of five years.

It may be asked why we recommend *annual vaccination* when the immunity conferred by a first inoculation is prolonged, according to our own experience, for at least eighteen months. To this we reply that the operation being harmless it is preferable not to await the limit of its action. Pasteur advocated annual vaccination in anthrax and swine erysipelas, and we follow in his footsteps.

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The tests will be continued, and the Pasteur Institute of Lille is placing their staff at our disposal.

Ballon.—The Reorganisation of Meat Inspection.—*Revue Vétérinaire*, November, 1924.

How should a national service for the inspection of meat be organised? Three instances will be cited :—

1. The case of large towns, of a given population, possessing a public abattoir of a certain importance, with specially nominated veterinary surgeons chosen solely for duty at the abattoir and to inspect all food sold on the market. These men should be put at the disposal of the towns by the State. The towns stand all to gain by placing at the head of their establishments competent, independent officials, and under the shelter of local influences. On the other hand, veterinary inspectors will benefit undoubtedly in the stability to which they have been aspiring for a long time; they will enjoy complete independence instead of being under the thumb of the users of the abattoir, and they need no longer fear being the victims of local political struggles. Besides, they will be assured of an order making their treatment and advancement uniform and supervising their change of quarters whether for personal convenience or advancement.

2. The case of small towns, but possessing nevertheless a public abattoir. The functions of the veterinary inspector should be entrusted to practitioners in the locality who would become in a small way State officials. I do not suppose that the bogy of officialism which some of us cultivate without valid reason will be a real obstacle to the recruiting of veterinary inspectors for the small towns.

3. The case of particular slaughter-houses. Inspection may be assured by the nearest veterinary practitioners. Their designation may be made according to agreement between the veterinary surgeon, the director of sanitary service, and the syndical section of the department. The emoluments may be fixed on a uniform scale, so as to avoid that bargaining and acceptance of reduced fees which are so unworthy of our profession, and which ought to be avoided at all costs.

As for industrial abattoirs, the solution is very simple: State veterinary inspectors will be detached to supervise and inspect these.

In departments where there are few veterinary surgeons and perhaps insufficient to ensure serious inspection, the question becomes less easy of solution, and this must be recognised. The difficulty is real, but not insurmountable. Agents may be appointed each of whom may operate in a stated area of the department; they will receive from the State fees sufficient to retain their services and also

the right to carry on private practice. Advantageous positions could be taken up in these regions and the practice of the veterinary surgeon be improved.

Such in brief is an organisation comparable somewhat to that of the veterinary surgeons who deal with scab in Algeria. I put forward these suggestions for what they are worth, and hope others interested will put forward solutions of this delicate problem.

Reviews

"Our Dogs" Christmas Number.

THE cult of the dog has attained such enormous proportions in all the English-speaking countries, that one can hardly be astonished to know that there are periodicals devoted entirely to news about this ubiquitous pet of the Englishman and his family. The paper known as *Our Dogs*, whose Head Offices are at Oxford Road Station Approach, Manchester, has attained a circulation which is world wide, and for a number of years the Editor has published a Christmas Annual in which there is to be found an account of every breeding kennel of note in the United Kingdom, together with a number from the Colonies and even from America. This year, however, the number has excelled itself, and it may safely be stated to be an almost complete illustrated encyclopædia of breeders and the champions of their kennels.

Its arrangement is popular and forms much pleasant reading, but in addition to that it is of practical utility as a dictionary and a work of reference. Printed on high quality art paper, the photographs illustrate every detail of outline and the text is extremely well put together by experts in the different breeds, without exaggeration in the description of the dogs or the owners.

The price is only 2s., and we recommend every veterinary surgeon to purchase this at once, as otherwise, the sale is so great, it is always out of print within a very short time.

The Meat Industry. By WALTER WOOD. Sir Isaac Pitman & Sons, Ltd., London. 3s. net. The Common Commodities and Industries Series.

AN outline in 100 pages of what the term Meat Industry means. Few in Britain realise that close on 900,000 tons of meat are imported annually into these shores.

The origin and handling of this meat are the main questions dealt with in this book.

Meat to a Britisher is an essential article of diet, and since approximately 50 per cent. of that sold in the shops is not home-killed, still less home-grown, a knowledge of whence and how the other half of his supplies is produced is of material economic interest to every householder.

Many consumers know of the local slaughterhouse: few realise that ofttimes its methods are insanitary; that technical inspection is rare; and that its wasteful system has to be defrayed by the purchaser. Few have had the opportunity of seeing the modern installations which go by the name of Meat Works, Packing Houses, or Frigorificos in different

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countries, wherein are prepared the animals for importation into England. In these premises, in the interests of the exporting country, no less than to safeguard the British consumer, science and hygiene predominate; economical methods of production reduce costs payable by the purchaser; blood, tendons, hair, bristles, etc., are all marketed. Further, meat from Overseas carries a *positive* mark of purity.

In Britain much of the home-killed meat escapes all inspection: true, Public Health laws permit of inspection, but except in large centres this is the exception rather than the rule—and there is nothing to denote inspection—nor is this always practicable with killings scattered over innumerable slaughtering-places.

Overseas, the inspection demanded is both *ante* and *post mortem*, and no carcase is marked unless this, and a detailed examination of all organs, has been carried out. This inspection is made by trained veterinarians, and their mark or label is a guarantee of purity.

Reference is made in this book to the relative supplies from within the British Empire, and to the disabilities under which Australia suffers owing to its great distance from London. The question of preference, or subsidy, or freight charges, alone does not enter here: rather it is that current demand is for chilled and not for frozen beef, and as yet no system of chilling has been introduced which will permit of conveyance with safety from that distance.

South America, only twenty-four days from England, has a great natural advantage: but she is also entitled to full credit for having during the past half-century adopted a consistent policy of stock improvement. The best of Britain's best have been demanded by the Argentine and Uruguay: and to-day these countries are reaping the reward of this far-seeing action.

Reference is also made to the possibilities of Africa entering this market: her situation is as favourable as that of South America, and she possesses, in many of her political territories, breeding stock capable of the same improvement as has been effected in America. Imperial policy will perhaps encourage this development in the African continent, thereby assuring to the British meat-eater the same quality and purity as he now enjoys, with the added virtue of being grown by our own race.

An increasingly wide interest in all matters appertaining to stock is taken by the veterinary profession: and the utilisation of the fruits of their labour, for which they have (or should have) given their guarantee of purity, gives to the subject of meat a particular significance. To those not intimately engaged in the meat industry, this little book is recommended as affording a general, lucid, and well-printed résumé of the history and current position of our meat supplies.

Inspection des Viandes et des Aliments d'Origine Carnée. Industrie et Législation. By MAURICE PIETTRE, D.Sc., Chief of the Laboratory of the Central Halls of Paris (Veterinary Sanitary Service of the Seine) attached to the Pasteur Institute; with a Preface by M. H. Martel, Member of the Academy of Medicine. Published by J. B. Baillière et Fils, 19 Rue Hautefeuille, Paris, in two volumes. Volume I consists of 439 pages with 95 figures; published in 1921; price 35 francs. Volume II consists of 682 pages with 113 figures; published in 1922; price 45 francs.

THE first volume deals with sound meat, and covers the whole field of

the meat industry very thoroughly. The author describes in detail the various methods of slaughter adopted in different countries, and gives a very full description of their abattoirs.

Methods of preservation receive due consideration, the portion of the book dealing with canning, and cold storage in particular, being treated in a highly technical manner.

The views expressed in the book concerning the use of preservatives are in keeping with the general idea which is expressed by the Departmental Committee which has just reported its findings to the Ministry of Health.

The author, having had the advantage of being able to visit abattoirs in both the old and the new continents, has been able to give to his readers the benefit of his experience and knowledge.

The first volume is completed with a chapter on the Technique of Inspection.

The second volume deals with unsound and diseased meat. It is divided into six portions. The first deals with diseased and unsound meat, meat poisoning in particular receiving full consideration; the second is devoted to the offals; the third to poultry and game; the fourth to fish; the fifth to horsemeat; and the last to the treatment of residuals.

The author gives the legislation (French) dealing with unsound and diseased meat, the repressive and preventive measures necessary, and deals in an exhaustive way with the various diseased and unsound foods met with. In the portion devoted to Anthrax, it is interesting to note that the use of neck-cloths by the meat carriers has resulted in a less number of cases of malignant pustule in man; and also, the propaganda carried out by veterinarians has made vaccination more popular and successful.

The portion dealing with Tuberculosis is specially interesting, inasmuch as the principle of indemnification is described. In France, compensation is payable for animals found to be affected with tuberculosis if they have been sent for slaughter to a public abattoir, or an abattoir placed under the permanent supervision of a veterinary surgeon approved by the Prefect; and also for animals sent to any slaughterhouse, provided that the owners have notified the veterinary officer before the slaughter of the animals.

The compensation payable is one-third of the value of the animal immediately before slaughter when the tuberculosis is generalised, three-quarters when the disease is localised, and full value when disease does not exist. In the case of partial seizure, the value of the meat and hide, sold under the control of the Mayor, is deducted from the indemnity. The books show a thorough knowledge of the subject and are a welcome addition to the existing literature. E. J. B.

Correspondence

VACCINATION AGAINST TUBERCULOSIS.

To the Editor of the VETERINARY JOURNAL.

DEAR SIR,—

I am obliged to Professor Gaiger for his letter on the above subject. The work of Calmette and Guérin * is based on the injection of *living*

* See pages 50 *et seq.* in this issue.

cultures of attenuated tubercle bacilli for the production of immunity in animals, whilst my vaccine is prepared from *dead* cultures of bacilli which have been attenuated for sixteen years by constant sub-culturing.

I have never found any reaction to tuberculin after the injection of my vaccine, but evidently a reaction does occur after the use of living bacilli.

Whether or not one immunising is sufficient to protect the animal for the rest of its life is not yet finally proved, as I have not had sufficient time to demonstrate this with certainty. Calves which were treated three years ago still fail to react to tuberculin.

The vaccine can only be successful in producing an immunity in animals which are free from tuberculosis or only slightly affected. It is of no use in advanced cases of the disease.

I am, etc.,

LONDON. NATHAN RAW.

JAN 24 1925 LIBRARY

PATHOLOGICAL MATERIAL URGENTLY REQUIRED.

Pieces of liver from :—

(1) Normal dogs (with a note of the method of destruction).

(2) Dogs which have died of distemper (in any form).

(3) Dogs which have died from jaundice.

Portions of muscle from braxy or black-quarter in sheep and cattle.

Bodies of chickens (or the living birds) suffering from bacillary white diarrhœa.

Specimens of the comb lesions in roup from every district of England.

Sick cats, or the bodies of cats, which have died from cat distemper or the so-called cat influenza.

The above are asked for by Mr. T. Dalling, M.R.C.V.S., of the Wellcome Physiological Research Laboratories, Langley Court, Beckenham, Kent, to whom any inquiries may be addressed.

Tubes for collection of same, with full instructions, will be sent to any practitioner on request.

Dr. F. A. Crew, M.D., D.Sc., Director of the Animal Breeding Research Department, The University, Edinburgh, asks for members of the profession to kindly send him the following :—

(1) Aborted fœtuses of all breeds of which the exact age is known.

(2) Skulls or heads of adult pure bred horses and dogs.

Expenses of carriage, packing, etc., will be refunded.

Dr. Nathaniel Lucas, 19, Westbourne Terrace, London, W., is engaged in research on the effects of violet ray irradiation on captive wild animals suffering either from rickets or that peculiar stiffness and loss of power of the hind-legs to which so many South American monkeys and marmosets are subject.

Several patients have already responded to treatment, and the investigation seems to promise favourable issue.

Animals (South American monkeys and marmosets) will be treated if sent in by any veterinary surgeon without fee, and will suffer no pain or discomfort, being returned to their owners when either cured or if considered to be incurable.

Erratum.—In connection with the article on "Sui Poisoning," the coin inserted in each of the illustrations was a shilling, and not a sixpence as stated.

THE SUPPLEMENT.

The attention of those who still require BINDING CASES for Major-General Sir Frederick Smith's "History of Veterinary Literature," Vol. II, is directed to the advertisement columns of the December issue.

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